ELECTRONICS Australia

May, 1970

40¢

Video recording vans for A.B.C. regional TV stations

BUILDING A FREQUENCY METER • A SIMPLE VHF RECEIVER

LINEAR MOTORS • TRANSCEIVER FOR 52MHz AMATEUR BAND

Registered in Australia for transmission by post as a periodical.

Printed and published by Sungravure Pty. Limited, of Jones Street, Broadway, at Morley Avenue, Rosebery.

ELECTRONICS Australia

incorporating RADIO, TELEVISION and HOBBIES

ABC certified circulation in excess of 50,000 volume 32, number 2

LOUDSPEAKER POWER RATINGS: *What do you do when you own a high-powered stereo amplifier but cannot afford high-powered loudspeakers to match its ratings? The article on page 112 discusses this very common problem.*

TAPE CASSETTES: *How do tape cassettes compare with discs in terms of content and quality? On page 121, Julian Russell reviews classical recordings recently released in cassette form.*

FREQUENCY METER: *This is a precision instrument which can take its place in any electronic laboratory. It will cost you much less than a commercial instrument. Page 40.*

1-WATT HANDSET: *Designed specifically for use on the amateur bands, this handset can be built for 52 or 144MHz, for either network operation or with a turntable receiver. Page 62.*

Editorial Office:
12th Floor, 235-243 Jones Street, Broadway, Sydney, Australia. Phone 2-0944.

Postal Address:
Box 2728, G.P.O., Sydney, 2001, Australia.

Advertising:
Manager, Howard Jenkins
Sydney Representative, Bill Summons. Office: 8th Floor, 235-243 Jones Street, Broadway, Sydney. Phone 2-0944.
Melbourne Representative, Clarrie Levy. Office: 392 Little Collins Street, Melbourne, 3000. Phone 67-8131.

Circulation:
Alan Parker, Manager. Office: 9th Floor, 235-243 Jones Street, Broadway, Sydney. Phone 2-0944.

Subscription Rates: See back page.

Representation:
Melbourne—John Fairfax and Sons Ltd., 392 Little Collins Street, 3000. Phone 67-8131.
Brisbane—Sungravure Pty. Ltd., 78 Elizabeth Street, 4000. Phone 2-6688.
Adelaide—John Fairfax and Sons Ltd., 104 Currie Street, 5000. Phone 51-3502.
Perth—Sungravure Pty. Ltd., 454 Murray Street, 6000. Phone 21-8217.
Newcastle, N.S.W.—Associated Newspapers Ltd., 22 Bolton Street, 2300. Phone 2-3696.
London—John Fairfax and Sons (Aust.) Ltd., Reuter Building, 85 Fleet Street.
New York—The Sydney Morning Herald Ltd., 1501 Broadway, New York, N.Y., 10036.

Distribution:
Distributed in N.S.W. by Sungravure Pty. Ltd., Jones Street, Broadway, Sydney, N.S.W.; in Victoria by Sungravure Pty. Ltd., 392 Little Collins Street, Melbourne; in South Australia by Sungravure Pty. Ltd., 104 Currie Street, Adelaide; in Western Australia by Western Press; in Queensland by Gordon and Gotch (A'sia) Ltd.; in New Zealand by Truth (N.Z.) Ltd.; in Tasmania by Davies Bros. Ltd., "Mercury," Hobart.

CONTENTS — MAY, 1970

features

technical digest

technical articles

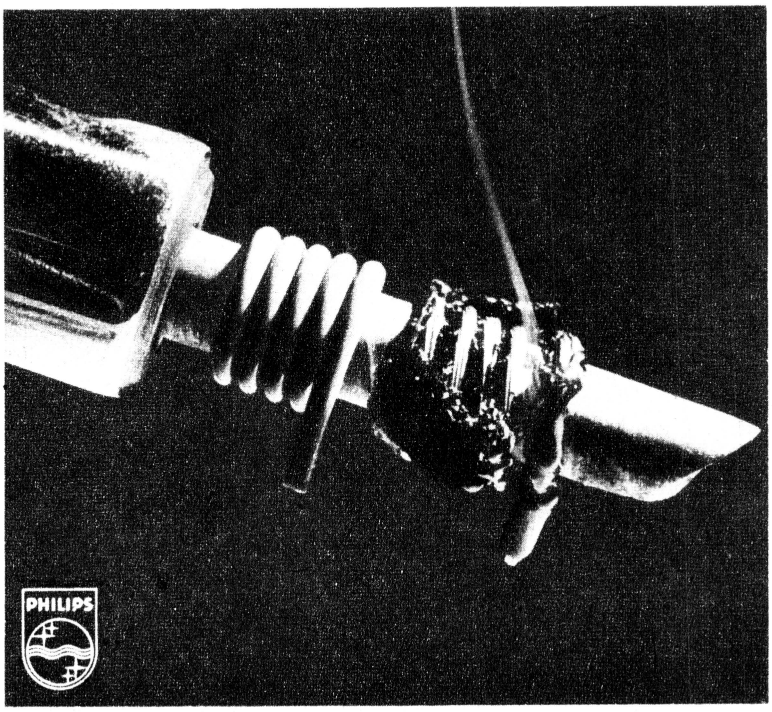
regular features

We proved Philips 'Teflon*' insulated Hook Up Wire withstands searing heat above 375°C.

★ Du Pont Registered Trade Mark.

This dramatic test shows normal commercially available PVC hook up wire disintegrating at a temperature of 375°C on the soldering bit. The Teflon Insulated Hook Up Wire remains unimpaired. Tested with Siemens Laboratory Thermocouple.

Teflon Insulated Hook Up Wire gives excellent, highly stable electrical properties. Minimum dissipation factor, low dielectric constant, highest volume and surface resistivity of any solid insulation...all constant over a wide range of frequencies and temperatures.



Plus high dielectric strength. Resistance to high temperatures and heat-ageing. Non-flammability. Inertness to corrosives, fuels and lubricants. Good mechanical properties. Unexcelled performance in space environments. Low coefficient of friction. Complete resistance to outdoor weathering.

Teflon wire is used in many diversified industries from...oil derricks...to space aeronautics.

Distributed by:

"Miniwatt"

Electronics Division of Philips Electrical Pty. Ltd.

Sydney • Melbourne • Brisbane • Adelaide • Perth • Canberra

PHILIPS

38.2753

EDITORIAL VIEWPOINT

by Neville Williams

Pirate radio

As we go to press, there are reports of a plan by two Sydney businessmen to operate a "pirate" radio station from a ship positioned off Sydney Heads, just outside the 3-mile limit. It is not at all clear what the sponsors could hope to gain from such a venture, since the residents of the Newcastle-Sydney-Wollongong complex have little in common with the pop-starved audience that earlier awaited pirate broadcasters off the coast of Britain and New Zealand.

However, if there is going to be one time more opportune than another for a pirate broadcaster to start up here, the present would possibly be it:

- There is a ship available, Tiri II. Radio Hauraki presumably has no further use for it, since becoming a respectable New Zealand commercial station.
- There are two or three disc jockeys around who would probably welcome the opportunity, once again, to grace the air waves with their presence.
- The record companies and the commercial stations, between them, seem to be well on the way to creating a potential "blackmarket" for a whole range of off-air pop sounds.

Australian regulations, gazetted in 1967, make it an offence to provide any kind of support or sustenance for a pirate radio venture, not only within Australian territory or territorial waters, but in waters "adjacent to Australia." In the face of such regulations, it would be very difficult for a pirate radio ship to remain functional, let alone to show any kind of a profit. By the time this issue actually gets into the hands of readers, it will probably be evident whether the sponsors of the scheme were serious or interested merely in gaining short-term publicity.

I imagine that the Australian broadcasting authorities will breathe a sigh of relief if nothing comes of the venture. Their relief will come from the knowledge that, on this occasion at least, the costs and embargoes will have proved an adequate deterrent for what would probably have been a commercial enterprise. If it were otherwise, the authorities in this country, as in most others, would have been hard put to it to deal with a broadcaster operating from the high seas with other motives.

I daresay that, if the problem of the offshore broadcaster became sufficiently widespread, action might be taken to add some international "teeth" to local regulations. At the moment the problem falls awkwardly in between: too local to provoke international intervention; too international for purely local control.

In the meantime, I.T.U. — the International Telecommunication Union — has more and bigger problems on its plate; problems which it would appear to be handling pretty well. We certainly wish it continued success. Otherwise, the possible invasion of national broadcast and television systems from satellite-borne transmitters would make the offshore broadcaster look a very trifling matter indeed.

ON SALE THE FIRST MONDAY OF EACH MONTH

On the cover

The A.B.C. regional station at Rockhampton has a new type of small video recording vehicle which allows more effective coverage of local news and other events. The unit carries a video tape recorder and camera channel for on-the-spot recordings which can be put to air within the hour. A similar vehicle is planned for the Townsville station. *(See story page 14.)*

INSTROL HI-FI

the largest HI-FI showroom in Australia.

✱ NOW you can build your own JBL speaker system.

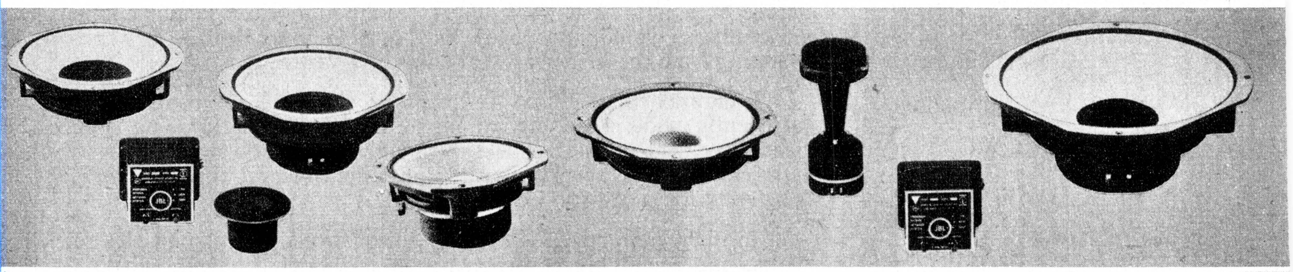
With Instrol cabinet kits and J.B.L. loudspeaker components.

JBL 032 SYSTEM

An outstanding speaker system designed for compact enclosures of 3 cu. ft or more. The 032 system comprises a D123, 12 inch low frequency loudspeaker, with heavily damped, long excursion cone assembly, 3 inch edge-wound copper ribbon voice coil and 6lb magnetic assembly. The JBL LE20, 2 inch direct radiator high frequency transducer, a unit of exceptional performance and versatility and the JBL LX2 precision dividing network, which features an H.F. attenuator and hand wound aluminium foil capacitors, individually checked to maintain accuracy to ± 1%
Frequency response 20-20,000 cps.
Impedance 8ohms.
CABINETS for JBL speaker systems are available in teak, maple or walnut finishes, and are both in kit form or built.

JBL LANCER 77 AND S11 SYSTEM

The LE10A LINEAR efficiency low frequency loudspeaker, with a 3 inch edgewound copper ribbon voice coil, lans-a-loy cone termination and a massive 10lb magnetic assembly, is normally combined with the LE20 high frequency transducer and the LX11 crossover network to make the S11 2 way speaker system. The S11 delivers smooth, full range performance and is ideally suited to our 2 cu. ft. enclosures. For more robust bass response the JBL PR10 "passive radiator" may be used in conjunction with this sytem in an airtight enclosure to effectively double the size of the speaker for greater dynamic range and smoother response well up into the mid-range.
Frequency response 30-20,000 cps.
Impedance 8-16 ohms.



JBL S1 SYSTEM

Although the LE14A 14in Bass loudspeaker has an area equal to that of many 15in speakers it may be installed in an enclosure as small as 2 cu. ft.! The large 4 inch diameter copper ribbon voice coil and massive magnetic assembly (total weight 21lbs) enable this speaker to faithfully reproduce the lowest fundamentals, even at high power levels. The JBL LE175DLH driver/horn/lens assembly consists of a compression driver, cast aluminium expotential horn and 14 element acoustic lens for 90 deg. high frequency dispersion in circular symmetry. Transition between high and low frequency transducers is controlled electronically by the JBL LX10 with variable H.F. attenuator.
Frequence response 25-20,000cps.
Power handling capacity 60 watts RMS.
Impedence 8-16 ohms.

JBL LE8T, PR8 SYSTEM

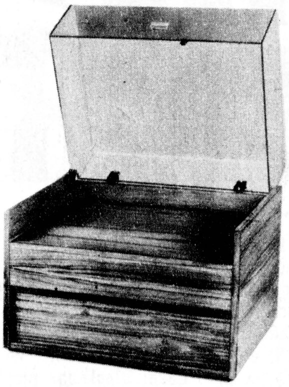
The remarkable performance of the JBL LE8T in a 1 cu. ft. enclosure cannot be matched by any other single speaker ever produced! The LE8T boasts a 2 inch edgewound copper ribbon voice coil, lans-a-loy cone termination and a 6½lb magnetic assembly. We now have available the C53 enclosure manufactured from JBL blue prints and measuring only 9in x 9in x 23in! The LE8T is ideally suited for mounting in walls or ceilings due to its shallow depth. For more prodigious base response the JBL PR8 passive radiator may be used to compliment the LE8T in airtight enclosures from 0.75 to 3 cu. ft.
Frequency response 30-18,000 cps.
Impedance 8 ohms.

CENTRE
91a York St.(between King & Market St.)

Easy to Assemble

INSTROL CABINET KITS

MAKE YOUR OWN HI-FI FURNITURE FOR LITTLE MORE THAN HALF THE COST



OUTSTANDING VALUE. Combined amplifier/player cabinet. Model 75. Complete with friction stay-up perspex cover. Available kit of parts or built and polished.

PRICE

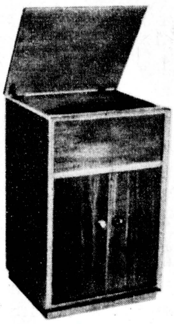
Kit of Parts, Teak	**$28.50**
Qld. Maple	**$25.00**
Built and Polished, Teak . .	**$41.50**
Qld. Maple or Walnut	**$37.00**

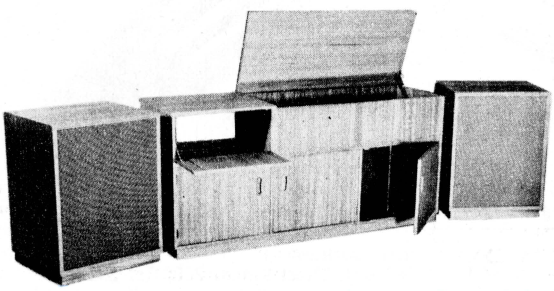
FREE INSTROL CABINET CATALOGUE

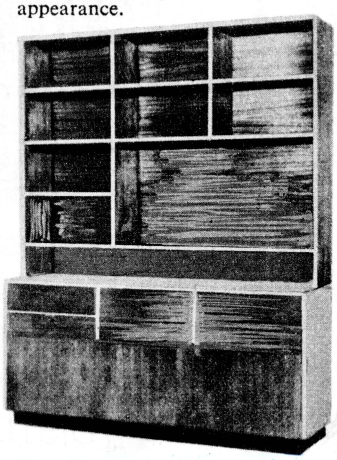
Post coupon, call, or phone for free fully illustrated Instrol hi-fi cabinet brochure. It includes full specifications and down to earth price details of all Instrol cabinet designs. (If writing please include postage stamp.)

Each kit is complete with all necessary timber parts, plus nails, screws, full, easy to follow instructions. Speaker enclosure kits are complete with acoustic Inner-bond lining felt, and acoustic grille cloth. Equipment cabinet kits include hinges, knobs, catches, sliding stays, castors, slides, leg sets, etc. All timber parts precision cut, fit together smoothly . . . panels are best quality veneered in selected Teak or Queensland Maple. Instrol cabinet designs will cater for virtually any make of speaker, player, amplifier, and tapedeck. If required, all designs are available ready built and polished, but it's highly economical and much more fun to make your own.

So easy, a child can manage it. The Instrol way — a new simplified method of assembly. A hammer, screwdriver, few hours of your time, and you can make for yourself a complete high quality hi-fi cabinet setting, fully professional in appearance.







INSTROL
HI-FI CENTRE
91a York St.(between King & Market St.)
SYDNEY, 2000
(opposite Rank Xerox Building)
Phone 29-4258

for descriptive leaflet post coupon
Please include postage stamp.
Name ______________________
Address ______________________
______________ Postcode ________
☐ Instrol Cabinets ☐ Hi-Fi Equipment

Tr13. The squelch pot is normally adjusted so that the emitter/base voltage is just bucked sufficiently to cut off amplification.

Transistors Tr14 and Tr15, connected as a Darlington amplifier, are shunted across the lower end of the squelch control and ground. The input to the Darlington pair is connected to the AGC voltage point on LM372. As soon as a signal is received and an AGC voltage developed, Tr14 and 15 conduct and cause the bucking voltage on the emitter of Tr13 to fall, permitting this stage to amplify normally. Diode D2 is included so that the normal emitter voltage of Tr13 does not appear at the collector of Tr14 and 15.

The emitter of Tr13 is by-passed to ground through a 20uF capacitor and call switch, S2. When S2 is placed in the "Call" position, the emitter by-pass capacitor is removed from its ground connection and fed to an RC feedback network connected to the output of the main amplifier. The resulting positive feedback loop causes the whole audio stage to oscillate at a frequency determined by the RC network, in this case, about 1KHz.

If the squelch is turned on and the control advanced to the point where Tr13 is cut off, oscillation will cease. As soon as a carrier is received, however, the removal of squelch bias will permit oscillation to commence and the resultant loud "beep" in the earpiece can be heard for some distance, indicating a call being received. The call switch is then turned off and communication established in the normal manner.

All switching functions from "receive" to "transmit" are taken care of by a single 4-pole, double-throw relay, operated by the handset push-to-talk button.

Relay contacts A/1 change over the aerial connection while the 12-volt supply line is switched by contacts A/2. The input to the audio amplifier is switched from the receiver section to the microphone input by contacts A/3, leaving the remaining contacts, A/4, to disconnect the output of the audio amplifier from the earpiece and feed it into the low impedance primary of the modulation transformer, T1.

The 100-ohm resistor connected across contacts A/4 provides a suitable level of side-tone in the earpiece during "transmit" and may be varied in value as desired.

Before considering construction details, the following general thoughts on component types, ratings and so on may be expressed to advantage.

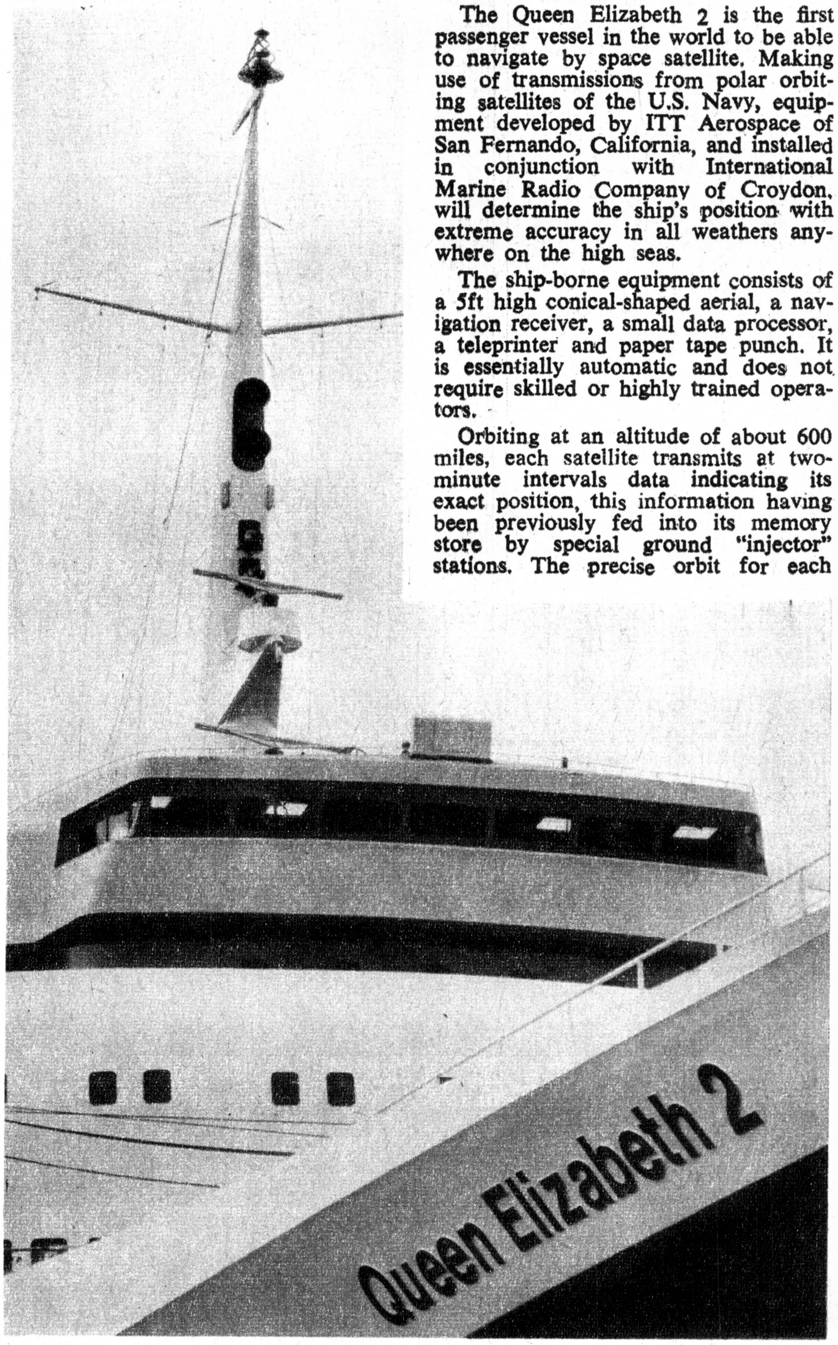
The BF115 transistor chosen for the low level stages in the transmitter, while only one of a number of types that could be used, has the advantage of availability, low cost and internal shielding. The shielding while not appearing to be essential in this case, could be an advantage in avoiding undesirable coupling effects sometimes experienced in compact equipment of this type.

Several transistor types were tried in the PA stage. We found little difference between them, most of the factors involved, cost, availability, power gain etc. being very much the same. While we settled finally on the BLY33, this was a fairly arbitrary choice of the types tried and they could be substituted without any modification to the circuit. It must be understood, how-

QUEEN ELIZABETH 2's

The new Cunard liner "Queen Elizabeth 2" has been described as "the most carefully planned ship ever built." Evidence of this careful planning can be discerned in the large array of electronic equipment the vessel carries. This article is concerned with the portion of this equipment supplied by the ITT group of companies.

Designed from the word go to act in a dual role—carrying passengers on the North Atlantic run from Britain to America and back during the summer season, doubling as a luxury cruise liner during the winter season—the Queen Elizabeth 2 is equipped with every modern convenience. Passenger comfort and convenience has been a major consideration all through the design stages: the ship has 13 decks and more open deck space than any other passenger liner; and more than 1,500 of the 2,000-odd passengers will have outside cabins.



The Queen Elizabeth 2 is the first passenger vessel in the world to be able to navigate by space satellite. Making use of transmissions from polar orbiting satellites of the U.S. Navy, equipment developed by ITT Aerospace of San Fernando, California, and installed in conjunction with International Marine Radio Company of Croydon, will determine the ship's position with extreme accuracy in all weathers anywhere on the high seas.

The ship-borne equipment consists of a 5ft high conical-shaped aerial, a navigation receiver, a small data processor, a teleprinter and paper tape punch. It is essentially automatic and does not require skilled or highly trained operators.

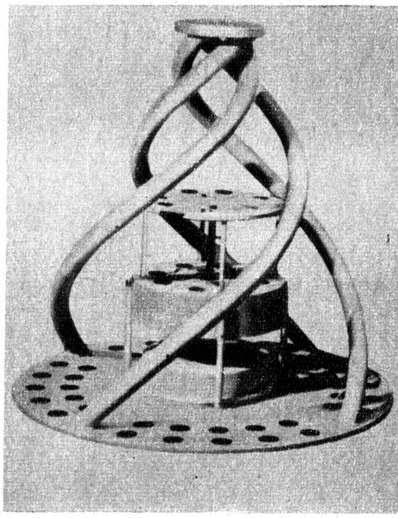
Orbiting at an altitude of about 600 miles, each satellite transmits at two-minute intervals data indicating its exact position, this information having been previously fed into its memory store by special ground "injector" stations. The precise orbit for each satellite having been predicted by computer from ground radar tracking measurements, information on its exact whereabouts for the ensuing 12-16 hours can be fed back into each satellite and used in its position broadcasts.

On board ship a small programmed data processor (Digital Equipment Company Limited, model PDP8/1) determines the ship's position from the received orbital data and from Doppler shift data provided by receiving equipment. The position can, in fact, be determined with extreme accuracy. When used as a completely self-contained receiving system, isolated from all sources of information except the satellite, position fix accuracies of the order of one-tenth of a mile can reasonably be expected. However, when used in conjunction with a second unit (on land), which is in simultaneous view of a satellite "pass," the relative position of one set with respect to the other can be determined to within 10 to 50ft.

The radio communiciations system is designed for extreme flexibility in use, and in this respect the Queen Elizabeth 2 is in advance of any other vessel in the world.

For nearly 40 years the International Marine Radio Company has been providing radio communication and navigation aids equipment on Cunard's passenger liners, including the two previous Queens, the Queen Mary and the Queen Elizabeth. Now the major part of the comprehensive radio system on the Queen Elizabeth 2 also has been installed by IMRC, the radio room being fitted out almost entirely with IMRC/STC/ITT equipment.

The heart of the radio communications complex is the receiving/operating room, situated aft of the bridge.



UNIQUE ELECTRONICS

Simultaneous independent working of four radio-telephony or radio-telegraphy channels is possible, there being four separate operating positions, each with its own aerial pre-selector unit (providing a selection of six aerials), a high-grade communiciations receiver (supplied by GEC), a transmitter exciter unit and remote-control unit, and an operator's control unit. Two of these operating positions have been built into pedestal-mounted console units, capable of being rotated through 90 degrees. This enables the radio officer at one of the fixed positions to take over and control a second operational position during periods when traffic is not so heavy.

"Split" headphones, having separate inputs to each earpiece, facilitate the simultaneous monitoring of two receivers. A main 500KHz distress frequency watchkeeping channel is provided in each headset selector unit, with automatic switching to a loudspeaker should all operators be occupied.

The control and switching panel at each operating position permits the radio officer to converse with the ship's telephone exchange operator to discuss details of outgoing and incoming radio-telephone calls, advance booking of calls, etc. Through this control panel, special circuits provide for direct communication with the bridge, the public address studio and similar places, and radio circuits can be made available to these points. In addition, it is possible to select here the use of teleprinters, to effect radio-photo reproduction, to switch either VOGAD (Voice Operated Gain Adjusting Device) or Lincompex (Linked Compressor and Expander) equipment in or out of circuit to improve speech quality, and to insert speech scrambling equipment to preserve privacy of conversations.

Because of the multiplicity of aerials used in the complex transmitting and receiving system—notch aerials, whip, dipoles and long wire—the aerial to be used is selected at each control position. A specially designed electronic display panel enables each operator to check the availability of all the ship's aerials, to see which are in use, and to which transmitters or receivers they are connected. Also displayed is the frequency band and channel that each of the transmitters is operating on. A receiver aerial patching panel facilitates the cross-patching of aerial feeds from remote receiving aerials to all receivers, including those located on the bridge, and a special feed to the sound reproducing equipment room. A supervisor's patch panel facilitates the monitoring and cross-patching of audio outputs from all receivers, the telephone exchange audio cables and lines to the bridge, the sound reproducing room and the public address studio.

It is also possible to communicate by teleprinter from the Queen Elizabeth 2 directly into the land telex networks. Accurate messages are ensured by the use of UNITEC error correction equipment supplied by STC. This detects errors caused by fading, noise or interference and applies a correction to those characters received with only a single element error. On those infrequent occasions, when more than one element error occurs in any character, a symbol is printed showing an error has occurred. During the Queen Elizabeth 2 acceptance trials as many as 20,000 words of Press material a day was handled.

Three of the latest type of teleprinter manufactured by ITT Creed are employed on the Queen Elizabeth 2. Two of these are used for these ship-to-shore communications. The third is used to print out information from the liner's computer.

The radio transmitting room, sited just forward of the funnel, is normally unmanned. It houses the remotely controlled power amplifiers of the four main transmitters, the exciter units and remote tuning controls for these being situated in the radio receiving room. One transmitter, type ST 1400, operates on both the medium-frequency and high-frequency bands (405-525KHz and 1.6-25MHz) and has an output of 1.5KW p.e.p. This was developed by STC's Swedish associate company, Standard Radio & Telefon, and was specially modified at IMRC's Croydon works for installation on the Queen Elizabeth 2. Three other transmitters, type ST 1430A, operate at HF only (1.5-25MHz) and have outputs of 1KW p.e.p. These, too, were developed by SRT and supplied and installed by IMRC.

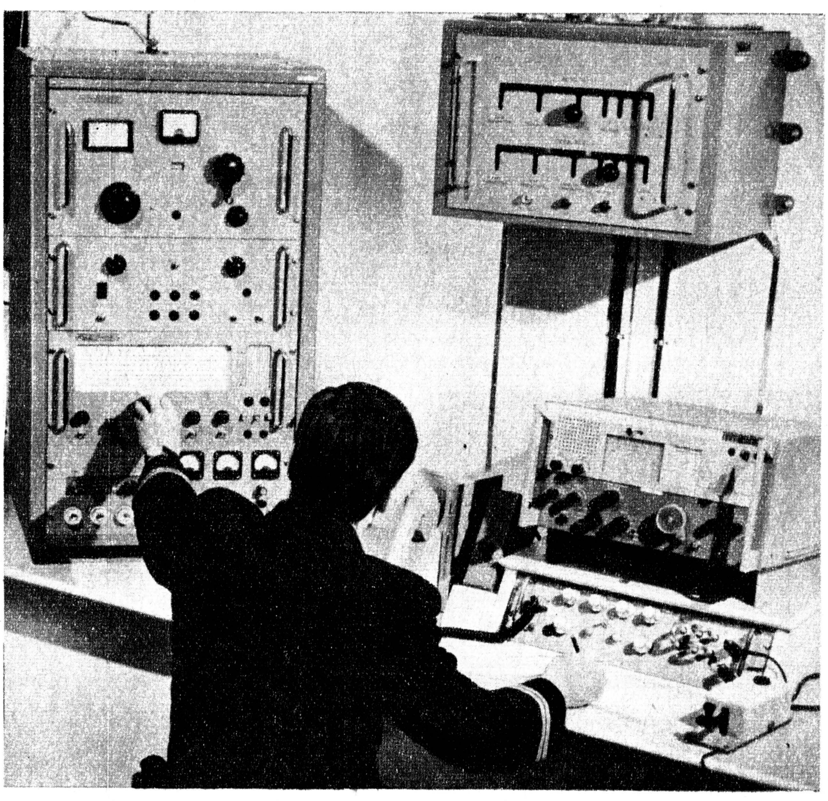
All four of the main transmitters have full double-sideband and single sideband capability for radio-telephony and equivalent facilities for radio-telegraphy. They operate into a variety of aerial systems, including notch aerials, the tuning of which is effected by remote control from the radio receiving room, as previously explained.

Also situated in the radio transmitting room is a transmitter, type IMRT-113, for reserve/emergency operation in the medium-frequency band, complete in a single-rack with a reserve/emergency receiver type SR.401, an automatic keying unit and facilities for switching to battery operation. On/off switching, keying, and aerial selection for this unit, can also be undertaken from the receiving room.

As well as the outstanding facilities provided for long-distance com-

This article, and the accompanying photographs, are reproduced from the "STC Quarterly Review" by permission of Standard Telephones and Cables Ltd., London, England.

LEFT: The helix shaped structure sited atop of the mast is the aerial for the satellite navigation system. A close-up is in the smaller picture.



RIGHT: Equipment for the Queen Elizabeth 2 under test at Croydon works of the International Marine Radio Company. On left is a stand-by receiver, and right is a high-stability main receiver.

munications, the Queen Elizabeth 2 carries VHF radio-telephone equipments for ship-to-shore communications, both for use by ship's officers and for public correspondence with coastal stations within range.

Of the four VHF transmitter/receivers installed on the bridge of the Queen Elizabeth 2, two are remotely operated from the radio receiving room.

One of those on the bridge, type STR 20 (10W, 16 channels), is used for communication with the ship's launches. The other, type STR 60 (20W, 41 channels), provides communication with tugs, harbour master's office, radar stations, etc., when entering or leaving port.

The two VHF transceivers remotely controlled from the radio receiving room, both STR 60, are primarily used for passenger or crew public correspondence services. If necessary, however, they can be used for ship-to-ship calls, port operations or distress services, thus supplementing the equipment normally operated from the bridge. These VHF equipments were manufactured by Standard Electric A/S of Copenhagen and installed by IMRC.

Almost every means of local and long-distance communication that would normally be available to them ashore is available to the 2,000 or more passengers who can be accommodated on the Queen Elizabeth 2.

The type of telephone exchange considered suitable for the high-grade personal service called for was a hotel-type PABX (Private Automatic Branch Exchange) having a manual switchboard. A specially designed 1,360-line exchange based on the G.P.O.'s type 3 PABX, and having a three-position cord-type manual switchboard, was supplied and installed by S.T.C.'s Private Communications Division at Footscray, Sidcup, Kent. This exchange provides 1,000 telephone extensions to passenger cabins, plus a further 360 extensions for ship's officers and crew and to working areas.

Timing and monitoring devices are included on the manual switchboard positions.

Telephone operators, located on No. 2 deck, provide a personal service for calls between passengers and between passengers and the crew, as well as for passengers' calls from ship to shore when the ship is docked. They are able also to arrange connection of radio-telephone calls while at sea. Really high-quality radio circuits are available for this latter purpose. Two high-frequency channels of the ship's radio telephony equipment are fitted with Lincompex terminals. Lincompex largely eliminates those variations in speech volume caused by fading, and reduces radio noise to a minimum, effectively suppressing noise between syllables of speech, thus making for easier conversations between callers.

For the businessman requiring speedy two-way communication with a written record, there is access from the ship into the U.K. telex service through the ship-to-shore radio teleprinter service.

Passenger telephones in the cabins of the Queen Elizabeth 2 provide automatic direct access to 30 of the ship's services, such as shops, hairdresser, and laundry. Calls to other passengers and ship's officers are made via the manual switchboard. Passengers can also learn the exact time, recorded in four languages, on a "speaking clock." The separate network of 360 extensions for the use of the ship's officers and crew only is fully automatic.

A separate telephone network is available for damage control emergency use. Provision is made beneath each break-glass fire alarm unit for a telephone handset to be jacked in, so providing direct connection between the control room and the locality in which trouble has occurred.

There are in addition 46 shore lines: provision is made at both Southampton and New York for direct telephone connection to be established directly the Queen Elizabeth 2 docks from the ship's exchange into the national telephone networks. By this means 30 lines are made available to passengers still aboard to telephone directly from the ship while it is in port, instead of having to disembark and use quayside telephone facilities. Another 16 lines are exclusive to the ship's business, including direct lines to the Cunard office.

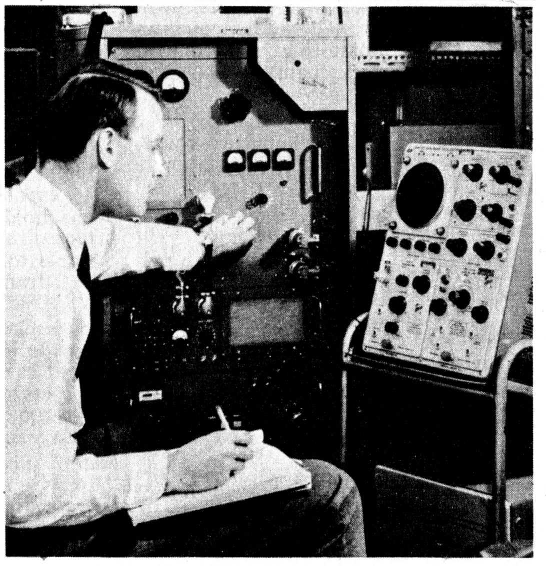
The cabling requirements for the 1,360-line telephone exchange on the Queen Elizabeth 2 were in some respects similar to the requirements of an exchange serving a small suburban area, but the installation problems were far more acute. Hitherto the normal method of installation has involved pulling separate cables through the distribution network from the telephone exchange to the various outlets. For the Queen Elizabeth 2 both time and cost were at a premium, so it was decided to resort to a technique that had never previously been adopted by the shipbuilding industry, although frequently employed in other applications, the technique of prefabricating the complete cable installation in harness form.

It was found that conventional multi-

(Continued on page 189)

ABOVE: A section of the radio receiving-operating room. The officer at centre rear is operating the remote controls of one of the long-distance transmitters. At left are the remote controls of another long-distance transmitter.

RIGHT: A type ST 1430A transmitter under test. These are remotely controlled and automatically tuned.



MOBILE VIDEO RECORDING

The A.B.C. has introduced a new concept into local television broadcasting in Australia, by bringing into service a small mobile recording unit equipped with video tape facilities.

The A.B.C.'s regional television stations provide news coverage and other programs of local interest, to supplement the main program material relayed from the studios in the capital cities over microwave links. Capital city stations use comprehensively equipped outside broadcast vehicles for on-the-spot live broadcasting and video recording. These units are virtually fully equipped studios on wheels, provided with several broadcast quality cameras, full monitoring and control facilities, and high quality microwave links. (Wide use is also made of filmed material for local news coverage.)

Since units of this complexity could not be justified for regional stations, local reporting has had to depend on filmed material alone. The limitations of film, and the delays occurred in processing have severely restricted the local cover of the regional stations. To provide fully effective local cover, mobile video tape recording facilities are essential.

Recently the A.B.C. decided to provide small vans to meet these requirements for the Rockhampton and Townsville regional stations. The basic requirements for these vans was a single camera video tape recording unit to provide adaquate cover of sporting events, news magazine interviews, and other items of local interest for documentary type programs.

After a study of the problems involved, including the economic ones, the following specification was adopted for the vans:

The complete equipment should be carried in a station waggon vehicle which should also serve as the production centre for the recording and assembly of programs. The vehicles should be air-conditioned.

The van should be simple to set up on location, and should be capable of being operated by two technical staff, together with production staff as required, i.e. producer, commentators, interviewers, etc.

The van should be capable of being operated from single phase 240V, 50Hz mains supply, or locally generated 240V, 50Hz supply.

The recorder should be a professional unit, capable of recording video and audio, and having comprehensive insert and assembly facilities. It should be capable of recording for at least one hour continuously on a single tape. The unit must be sufficiently stable to permit direct replay to air or transcription to an Ampex VR1000C recorder.

The camera should be a lightweight broadcast quality vidicon or Plumbicon camera having a low power consumption and no separate camera control unit. It should be fitted with a zoom lens.

Audio mixing facilities for at least four separate microphone channels are necessary.

Full intercommunication and talkback facilities are required.

The equipment should be designed for monochrome only, and no luminaires or lighting control equipment need be provided.

The vehicle selected was a Ford Fairmont station waggon which was fitted with a V8 engine, disc brakes, modified engine cooling system, heavy duty tyres, heavier suspension and a number of other facilities.

The operating position has been chosen such that one operator within the van is seated in the driving position whilst the second operator sits in a separate seat directly behind the driver. All operational equipment is located in a specially designed frame situated on the left hand side of the vehicle. The operating position is designed so that the operator in the front seat controls the video recorder and audio facilities, whilst the operator in the rear seat controls the intercom and talkback system together with a number of secondary controls. The layout has been arranged so that one operator seated in the forward seat can adequately operate all the equipment, if necessary.

The camera selected was an Ampex BC300. This is a Plumbicon camera of broadcast quality and includes an electronic viewfinder, an integral synchronising pulse generator and a zoom lens. The camera can be operated from a battery pack or from 240V mains, and does not require a separate camera control unit. One big advantage of this camera is that it may be hand-held or tripod mounted, and it requires only a single video cable feed to the van. A cable compensator has been provided to enable up to 200ft of camera cable to be correctly equalised.

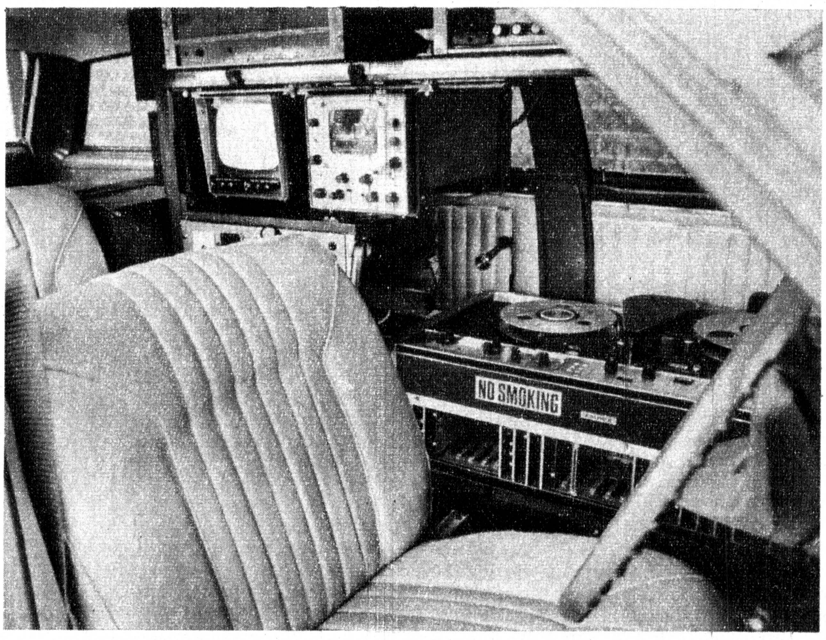
The video recorder is an Ampex VR7800-03 which is a single head, 1in helical scan machine. The recorder has comprehensive insert and assembly facilites for both video and audio, and it includes an output processor which ensures continuity of synchronising pulses in the video output waveform. The recorder has been wired so that it is normally locked to the camera signal. However, it can be locked to station sync. for replay at the studios.

The vision equipment includes a synchronising pulse generator which is gen-locked to the camera, and a ten step grey scale generator which is used for alignment and test purposes. A high quality 8in picture monitor and a professional waveform monitor are also included, and these may be switched to monitor various video signals. Program vision is available at all times for use external to the van for commentator's picture monitors, etc.

Audio facilities are provided by a four channel mixer, together with a compression/limiter amplifer. The program sound is fed through an amplifier within the recorder to a small loudspeaker located within the van. Program sound is also available at all times for use external to the van.

The intercom and talkback system comprises a base unit installed in the van, together with separate remote units for the cameraman and the commentator.

The cameraman is fed with program sound and production talkback, and the commentators receive production talkback and intercom. In each case the



Interior view of the prototype mobile video recording van.

UNITS

intercom and talkback is carried on a single run of microphone type cable.

All connections external to the van are made through a single connector panel which is situated in the centre of the rear bumper bar of the van. Additional facilities include a tripod with pan and tilt head, a roof platform with tripod clamps, an automotive type air-conditioning unit of about 20,000 B.T.U. capacity, microphones, stands, 9in house-quality picture monitors, and headsets.

All cables are wound on aluminium cable drums carried in the rear of the van. The drums accommodate the following lengths of cables: 700ft power cable, 1,000ft video cable and 1,200ft of audio/talkback cable. A cable winder is also supplied.

Extensive investigation was undertaken to determine the most suitable means of providing the internal 240V, 50Hz power source for this van, and it was eventually decided that generation of 24V DC from the vehicle engine, together with an inverter, would provide the most flexible and reliable system. This had the added advantage that operation of the equipment would then be possible while the van was being driven.

The internal power source comprises two alternators driven from the vehicle's engine, with rectifiers providing two supplies of 55 amps DC, one being at +12 volts and the other at — 12volts. This output is used to continually charge two 12V lead acid batteries located in a ventilated battery box in the rear of the vehicle. These two batteries are connected in series to supply 24V DC to a 1KVA solid state inverter whose output is then available to feed the equipment. Control of the internal power is by means of a magnetic clutch mounted on the fan pulley of the vehicle and a hand throttle. The two batteries are normally charged continuously by the alternators; however, should a fault condition arise, the equipment can operate for about ½ hour from fully charged batteries.

Core balanced circuit breakers are fitted to both the internal and the external power supplies to provide personnel and equipment protection in case of a mains fault situation arising.

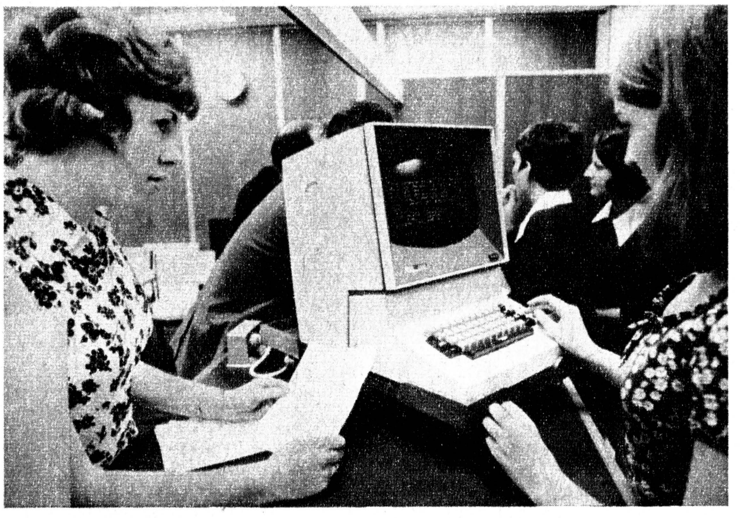
The van has now been in service for several months and has proved to be quite successful within the limitations of a single camera. Perhaps its greatest advantages are that it may be driven to any location in the same way as a normal motor vehicle would be driven. and that it can be set up by two people in less than one hour, even for a relatively complex program. This enables the van to be used both for normal coverage of lengthy outdoor functions, such as sporting events, and for local news reporting. It has been found that material may be recorded on location, then replayed to air approximately one hour after completion of recording.

ACCOUNTS QUERIES ANSWERED IN SECONDS

An IBM computer system installed by Melbourne's Gas and Fuel Corporation provides information against customers' accounts queries in seconds.

The computerised inquiry centre, the first of its kind in Australia, was officially switched on recently by Mr Neil Smith, chairman and general manager of the utility. More than 20 terminals are installed in the centre to handle both over-the-counter and telephone inquiries. Operators merely key-in the customer's address or account number to retrieve a display of account information on the screen of an IBM 2260 Visual Display Terminal.

The terminals are connected to an IBM System/360 Model 40 at the Gas and Fuel data processing centre. Details of meter readings and customer accounts are kept on magnetic discs in two IBM 2314 direct access storage facilities. Each can store some 400-million digits of data and the computer can retrieve a customer's record in 75 milliseconds.



One of the IBM 2260 Visual Display Terminals used in the system.

The system has reduced the time required for answering accounts queries from an average of four minutes to 30 seconds. Queries include problems with accounts, or requests for final bills from people moving premises.

As the customer explains the problem or makes his request, the operator sees details of the account displayed on the screen. For instance, a report of a sudden rise in gas consumption can be checked immediately against past history, and, possibly, traced to new appliances, while the customer is on the phone. If no satisfactory explanation is found on the basis of available data, Gas and Fuel engineers can be alerted immediately to trace the trouble.

Describing plans for extension to the customer inquiry system, Mr Smith explained, "This initial application is only the first part of a fairly long term project to enhance our service to the gas consuming public. Our aim is to reduce costs and at the same time reduce the time to answer inquiries. An even more exciting application of the computer, one which will improve customer service still further, is currently being examined. Under the extended system a customer calling for service will be given a definite appointment immediately, the computer allocating the work to an individual fitter and issuing the necessary job tickets and other documents automatically. Unfortunately the complete system will not be available to help us over the winter months ahead, but, in the meantime, customers will note a much more rapid response to inquiries relating to the financial side of the account."

Internally, Gas and Fuel Corporation credit officers use the terminals for quick checks on delinquent accounts. A decided advantage of the new system over the conventional procedures is the ability it gives the officers to immediately alert the computer, via one of the terminals, on payment of arrears as agreed by a customer.

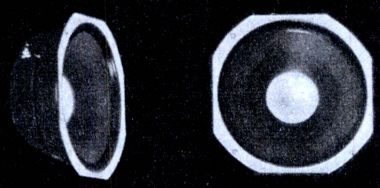
At the inauguration of the new system, Mr Smith said: "With the aid of the terminals we have reduced the average time for answering a telephone inquiry from approximately four minutes to 30 seconds, that is, a factor of eight. The inquiry centre handles up to 2,500 account inquiries per day. Time savings are therefore most significant in gaining customer goodwill and in promoting service efficiency."

"We are particularly impressed," Mr Smith added, "with the speed and ease of implementing the system and of training our inquiry staff."

Mr J. P. Watson, manager of systems and data processing at Gas and Fuel Corporaton, pointed out that operators required only a few hours of familiarisation in the handling of inquiries with the aid of the terminals.

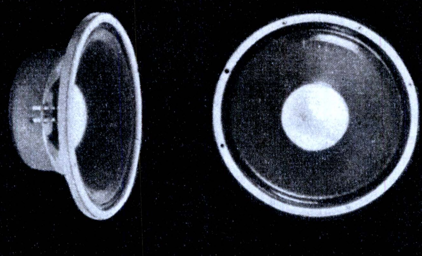
JBL

Musical Instrument Loudspeakers



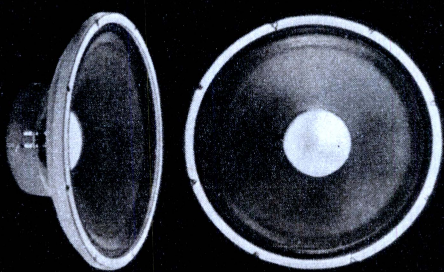
D110F SPECIFICATIONS

Nominal Diameter	10 inches
Magnetic structure	6 pounds
Impedance	8 ohms
Power Capacity RMS	100 watts
Voice coil diameter	3 inches
Voice coil material	Edgewound Aluminium Ribbon
Flux Density	10,200 Gauss
Total Flux	170,000 Maxwells



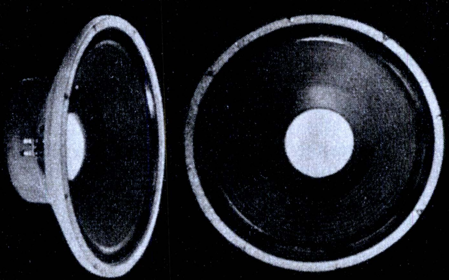
D120F SPECIFICATIONS

Nominal Diameter	12 inches
Magnetic structure	11 pounds
Impedance	8 ohms
Power Capacity RMS	100 watts
Voice coil diameter	4 inches
Voice coil material	Edgewound Aluminium Ribbon
Flux Density	12,000 Gauss
Total Flux	275,000 Maxwells



D130F SPECIFICATIONS

Nominal Diameter	15 inches
Magnetic structure	11 pounds
Impedance	8 ohms
Power Capacity RMS	100 watts
Voice coil diameter	4 inches
Voice coil material	Edgewound Aluminium Ribbon
Flux Density	12,000 Gauss
Total Flux	275,000 Maxwells



D140F SPECIFICATIONS

Nominal Diameter	15 inches
Magnetic structure	11 pounds
Impedance	8 ohms
Power Capacity RMS	150 watts
Voice coil diameter	4 inches
Voice coil material	Edgewound Copper Ribbon
Flux Density	11,500 Gauss
Total Flux	260,000 Maxwells

JBL DEALERS

ALDERSONS CAMERA & HI FI CENTRE,
THE NEWTON BUILDING,
THE KINGSWAY,
CARINGBAH, 2229.

BRISBANE AGENCIES,
78 WICKHAM STREET,
FORTITUDE VALLEY, QLD., 4006.

CONVOY INTERNATIONAL,
449 KENT STREET,
SYDNEY, 2000.

GLEN-DOR CAMERA & HI FI CENTRE,
43 THE CORSO,
MANLY, 2095.

ENCEL ELECTRONICS (STEREO) P.L.,
257 CLARENCE STREET,
SYDNEY, 2000.

KEITH ABERNATHY STEREO,
92 BOURKE STREET,
MELBOURNE, 3000.

HOMECRAFTS HI FI CENTRE,
PETRIE STREET,
CANBERRA CITY, A.C.T., 2601

ALVIN COMMUNICATIONS,
38 PEGNULL STREET,
PIMLICO, 4810
TOWNSVILLE, NTH. QLD.

ALLANS MUSIC CENTRE,
276 COLLINS STREET,
MELBOURNE, 3000

INSTROL HI FI CENTRE,
91A YORK STREET,
SYDNEY, 2000

KENT HI FI,
432 KENT STREET,
SYDNEY, 2000.

PFITZNER'S MUSIC SALON,
BOX 2289, P.O.,
DARWIN, N.T., 5794.

W. WATERS & SONS P.L.,
CNR. CROWN & STATION STS
WOLLONGONG, 2500.

STEREO SOUND SYSTEMS,
56 RUSSEL STREET,
MELBOURNE, 3000
SHOP 12,
PRINCES GATE ARCADE,
FLINDERS STREET,
MELBOURNE, 3000.

PARISE SOUND SYSTEMS,
P.O. BOX 14,
ELIZABETH, S.A. 5112.

THE MUSES SOUND SPECTRUM,
33 REGENT ARCADE,
RUNDLE STREET,
ADELAIDE, S.A., 5000.

MOVING MAP AIR NAVIGATION SYSTEM ON TOUR

A new Marconi airborne navigation system with an advanced pictorial display is currently being demonstrated under operational conditions in the company's Piaggio aircraft to representatives of major airlines from the United States, Europe and the U.K.

The Marconi Type AD670 fully automatic area navigation display can cover an entire airline route structure. The current tour provides the first opportunity that the majority of aircraft operators have had to evaluate the advantages of this type of automatic area navigation presentation in airborne operation.

The system is based on a 6-inch diameter moving map display, using back-projection film techniques to present a detailed map of the area in which an aircraft is flying. The map moves under the control of a navigation computer, to show the "present position" of the aircraft at the centre point of the display. The pilot can see at a glance his position in relation to any required track, waypoint or destination, and can identify navigational aids or topographical features with reference to this position.

This system is completely automatic, and can operate from any of the normal "en-route" navigational aids including doppler and inertial systems, VOR/DME, and all types of hyperbolic navigation aids.

A major advantage of the Marconi moving map display is the very large film capacity — more than four times that of other types of moving map display, and sufficient to accommodate on one film a series of at least 1024 overlapping maps covering the entire route structure of any airline in the world, with additional space for procedural check lists and lists of radio facilities. A choice of up to four map scales can also be provided on the same film strip. A military operator could cover his entire area of operations on a single film. It would even be possible to accommodate the vast majority of all the international routes of all airlines in the world.

This very large storage capacity, capable of holding at least 130ft (39 metres) of film in a single loading, will largely eliminate the need to change the film in normal operations, and this in turn will greatly increase the reliability and operational effectiveness of the system as a whole.

Separate frames on the film provide four different map scales on the same film strip. This provides greater detail of ground aids, airways or topographical details. These four different scales can be provided to suit any particular operational requirement, and are selected by means of a switch on the display unit.

The system can be switched to give either a track-up or a North-up orientation of the display. In the track-up mode, the pilot can also switch to a "Look ahead" presentation, in which the "presentation position" point is moved from the centre to a point near the bottom of the display, in order that the maximum portion of the map display is used to show the area ahead of the aircraft.

All of the map frames overlap with adjacent sections of the map, to avoid any discontinuity of display as the aircraft approaches the edge of the map frame. Well before this edge is reached, the computer moves the film automatically to the next appropriate section of the map, which also has an overlapping area. At the same time, the computer ensures that a map frame of the correct scale is selected, and that the position and orientation of this map are correctly displayed. Any type of map projection, or a combination of different projections, can be used with the display system, and the appropriate co-ordinate conversion functions provided in the computer. In civil use, the display will normally use airways and en-route type navigation charts, at a scale appropriate to the information required.

High visibility over a wide viewing angle is another important feature. Several levels of projector illumination can be provided, and selected by a switch, to suit extreme variations in light level on the flight deck. During the current demonstrations, the Marconi team have been able to show that the map can still be clearly seen with sunlight falling directly on the face of the display. Four independent lamp units are housed in the display, to provide immediate replacement in the event of a lamp failure.

The equipment can also provide a vertical navigation display, to enable a pilot to follow a let-down path accurately at any given angle. The display will present height plotted against a horizontal scale of "distance to waypoint," with lines running across the display to correspond to a range of letdown angles. Data from the air data computer system provides an altitude input while distance to go to the waypoint is provided by the navigation computer.

The moving map display in the cockpit of the Marconi Company's Piaggio demonstration aircraft.

The complete system has been designed to take maximum advantage of the latest integrated circuit techniques to provide very high reliability and small size and weight. A wired-in program provides all the facilities necessary for any specified set of customer requirements, but results in a much simpler computer system than would be needed if facilities were to be provided to change the program.

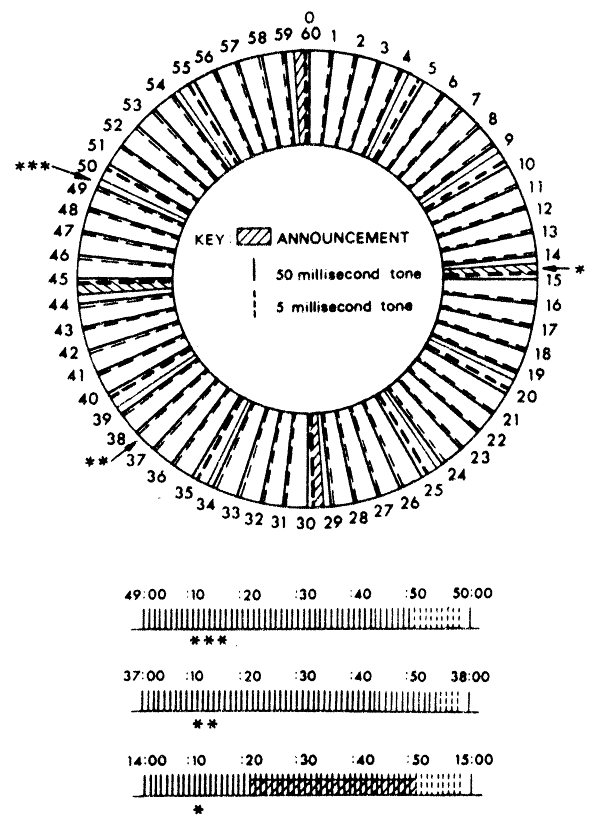
The computer can be used to drive digital displays of range and bearing, or of Northings and Eastings if required.

IMPROVED TIME SIGNAL SERVICE

Following the installation of new equipment at the P.M.G.'s Time Signal Service Station at Lyndhurst, Victoria, the carrier frequency is now stabilised to a high degree of accuracy.

The time signal service from VNG Lyndhurst provides precise time signals for the use of scientists and other interested parties. Typical of those who make use of the service are astronomers, seismic and geophysical exploration teams, observatories, academic groups, industrial organisations and Government departments.

VNG TIME CODE



This diagram represents transmissions from VNG over a one-hour period. Signals are coded to indicate each second, each minute, each fifth minute, each quarter-hour and each hour.

The first four minutes of each five-minute period have identical coding: a 50-millisecond tone is transmitted to mark each second from the first second of the minute to the 54th second; the 55th second to the 58th second are marked by a 5-millisecond tone, the 59th second is silent, and the minute is marked by a 50-millisecond tone. The pattern is then repeated for the next three minutes. (This pattern is marked by two stars in the diagram.)

At every fifth minute, 50-millisecond tones are transmitted each second from the first to the 49th second, followed by 5-millisecond tones from the 50th to the 58th second, the 59th second is silent, then the minute is marked by a 50-millisecond tone. (Pattern marked by three stars.)

The code for the minute preceding the 15th, 30th, 45th and 60th minute is identical with the fifth-minute code, except that there is a 30-second announcement identifying the station from the 20th to the 49th second. The 50th to the 58th second are marked by the 5-millisecond tone, the 59th second is silent, then the hour is indicated by a 50-millisecond tone. (Pattern identified by one star.)

Similar services are operated by overseas organisations on carrier frequencies set aside for the purpose by international agreement. While such transmissions from overseas are valuable, they cannot always be received and used in Australia because of the lengths of the transmission paths involved. Apart from fading, other factors which have to be considered are confusion arising from reception of more than one service on the same carrier frequency, and propagation delays.

The transmissions from VNG are at present classed as experimental, and as such they do not take place on carrier frequencies reserved for time signal transmission. The present schedule of VNG transmissions is as follows:

TIMES OF EMISSION		FREQUENCY
UT	AEST	KHz
0945-2130	7.45 p.m. — 7.30 a.m.	4,500
2245-2230	8.45 a.m. — 8.30 a.m.	7,500
2145-0930	7.45 a.m. — 7.30 p.m.	12,000

The time signals transmitted from VNG have been controlled by a caesium beam standard from the inception of the service in 1964. Now the carrier frequencies are also accurately stabilised from the same source. In addition, the power of the transmissions has been raised from 1KW to 10KW.

The accuracies and stabilities of the service are now as follows;

CARRIER FREQUENCIES. Stability will be maintained such that average daily fractional frequency deviations from the nominal value do not exceed plus or minus one part in 10^{10}. Nominal in this case refers to the value derived from the standard for measurement of the time interval UTC (APO) maintained at the Australian Post Office Research Laboratories, and which is referred to the Universal Co-ordinated Time scale as determined by the Bureau International de L'Heure (B.I.H.).

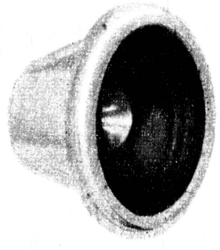
The Lyndhurst site has its own controlling and standby frequency standards which maintain the carrier frequencies and time signals to a very close tolerance. Off air measurements of the transmissions are made daily at the P.O. Research Laboratories. A VHF link from Lyndhurst to the laboratories also continually supplies frequency and time information with minimum degradation, since VHF propagation is less subject to disturbance than are HF transmissions. VHF transmissions are not usually subject to ionosphere changes, and it is ionospheric disturbances which places probably the greatest limitation on the accuracy attainable in disseminating time and frequency information by HF transmissions.

The frequency standard system at the VNG transmitters is controlled from the research laboratories by a signal sent via landline. The crystal oscillators at Lyndhurst incorporate motor driven capacitors, which are used to correct the crystal frequency as variations occur.

The frequency controller at Lyndhurst allows the frequency of the controlled oscillator to be maintained within one part in 10^{11} of the controlling standard. Information to the controller is provided by a frequency in the VLF range derived from the master oscillator at the research laboratories and sent to the Lyndhurst site via landline.

The advantages of this is that should the controlling frequency vanish for any reason, the controller will hold the controlled oscillator tuning capacitor to the last known controlled position until the reference frequency is restored. The time constant of the frequency controlled loop can be varied up to a maximum of several days to suit the conditions under which the control operation is taking place.

BUY RIGHT... FROM ENCEL.



8" Onkyo Speaker gives 12" speaker performance

Even at first glance this 8" speaker commands attention. It is extremely well engineered and the design is thoughtful to say the least.
8" co-axial speaker with six magnets; horn type tweeter; electrical cross-over; frequency response 35-20,000 Hz, (the response curve is substantially flat). Weight: 8lbs without enclosure.

Price (including tax) **$36.50**

Tape head demagnetisers

Just plug in to any AC power outlet and pass over the heads. Takes only 5 seconds—makes a world of difference. Two models: single or double probes.

Price (including tax) **$4.50**

Compax Solid State Tuners

This high quality, wide band AM tuner, represents outstanding value for money. Output suits all amplifiers and tape recorders. A teak finished outer case is optional.

With case (including tax) **$49.50**

Trade-in/Trade-up

Let your old equipment in working order earn money for you. Bring in your old tone arm, amplifier, tape recorder etc., for valuation when making a purchase. Encel's generous trade-ins will surprise you.

Canberra Enquiries

For full details of all Encel equipment Canberra residents should phone 81 1667.

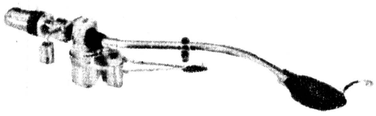
Encel Service Division

Our service divisions are staffed by qualified electronics technicians. Our facilities include the latest laboratory test equipment. Don't take risks—Encel service is guaranteed.

Lustre Tone Arms
Top quality arms at ridiculously low prices

ST 510. Fully fitted with minute ball races; outrigger type bias adjustment; counterweighted stylus adjustment; accepts all standard ½" cartridges.

Price (including tax) **$19.00**



ST-510D (illustrated) is fitted with a hydraulic lift/lower device.

Price (including tax) **$24.50**

Speakers cost less at Encel

Save on all the famous make speakers at Encel. Speakers from all over the world . . . and to meet every requirement. Akai, Compax, Celestion, Derham, JBL, Janszen, KEF, Kenwood, Lowther, Sansui, Sonics, Sony, Stentorian, Wharfedale.

For Record Protection:

Lustre Universal Tone Arm Lift

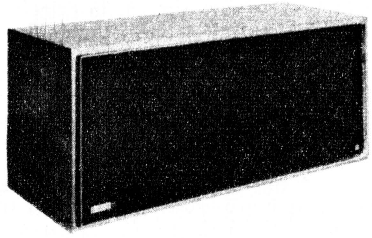
Fits all tone arms; pneumatically controlled lift/lower action is smooth, gentle and certain. Your records deserve 'Lustre' care.

Price (including tax) **$8.50**

Save more on Tape Recorders

All the best makes cost less at Encel: Akai, Sony, National, Toshiba, Mini Philips, Revox, Tandberg, Truvox, Clarion, HMV, Kriesler . . . and many more. Check Encel's prices, and save more at Encel.

Celestion Speakers

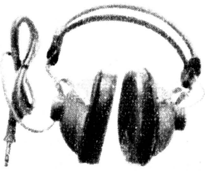


The outstanding Ditton 15

Dimensions: 15" x 21" x 9½." Incorporates a HF 1300 MK II tweeter, a new type bass drive unit and a highly sophisticated auxiliary bass radiator.
Extract of Review from "Hi Fi Sound" ". . . hard to realise sometimes that so small a speaker was really producing such well defined low frequency sounds. It goes without saying that the treble performance was fully up to standard of the HF 1300."
Extract of Review from "The Gramophone." "The listening tests made an excellent impression."
Extracts from "Hi Fi News." "The quality of the bass sound was above average . . . always clear and bright."

Price (including tax) **$94.50**

Sonics Stereo Headphones



Comfortable, offering fatigue-free personal listening.

Price (including tax) (HS-304) **$12.50**

Price (including tax) (HS-303) **$9.50**

Lowest prices in Australia for famous-make Turntables

BSR, Compax, Connoisseur, Dual, Garrard, Goldring, JH, PE, Thorens.

ENCEL

ELECTRONICS (STEREO) PTY. LTD.

Head Office: 431 Bridge Rd., Richmond, Victoria. 3121. Tel. 42 3762.
Sydney Store: Ground Floor, 2SM Building. **257 Clarence Street, Sydney, N.S.W. 2000. Tel. 29 4563, 29 4564.**
Australia's Greatest Hi-Fi Centre ■ Wholesalers ■ Trade-ins accepted ■ Terms

Background Information

An understanding of this article presupposes a knowledge of the principles of operation of linear induction motors. Readers not familiar with these motors may find the following helpful.

The linear motor is similar in principle to the "squirrel cage" type of polyphase rotary induction motor. With the later type of motor, the rotor is induced to turn in its bearings by following the rotation of the magnetic field produced around it by the stator. The rotor itself is magnetised by induction from the stator windings. The advantage of this type of motor is its simplicity, since it requires no brushes or rotor windings.

Assume now that it is possible to cut through the stator assembly in one place, and lay it out flat, without interupting electrical continuity of the windings. The magnetic field now will travel continually in one direction along the length of the stator. The "rotor" now can be a flat rod, or rail; or, as in the case of the liquid metal pump, molten metal in a tube. The rotor and stator can reverse roles, so that the windings move along a fixed rail.

LINEAR MOTORS— inefficient but effective

Linear motors, almost totally neglected since their invention 80 years ago until fairly recently, are now considered practical units for some specialised applications, and are already being used in atomic power plants.

by Professor E. R. Braithwaite

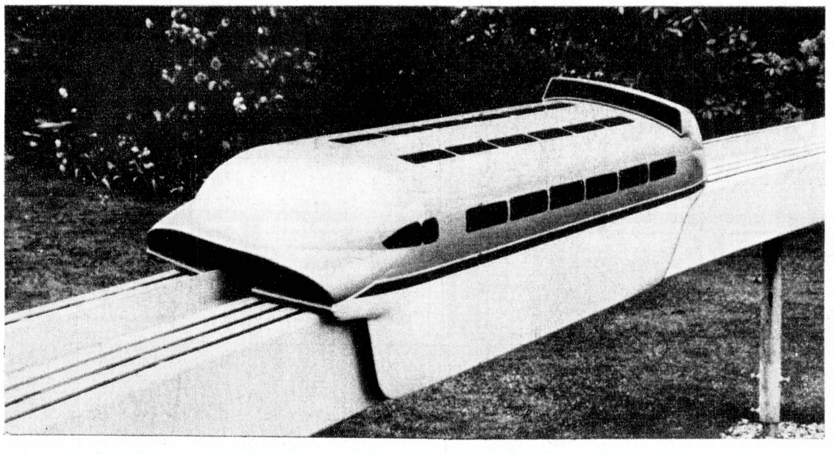
Dept. of Electrical Engineering, Imperial College of Science and Technology

The development of the linear motor could be said to have taken place in three distinct phases. Invented in 1890, the first phase occupies the period almost up to 1950, during which time a number of attempts were made to apply it commercially, most of which came to the conclusion that it was costly, inefficient and belonged only, perhaps, to a museum of scientific curiosities.

There was one notable exception during this phase which, in one sense, indicated the way in which future developments would occur. This was the liquid metal pump which involved several forms of construction, in all of which the effective airgap was much larger than that of the conventional rotary motor. Figure 1 shows a cross sectional view of a double-sided flat type. The liquid metal, a mixture of sodium and potassium, is contained in a stainless steel walled tube so that the total airgap in the magnetic circuit is several inches. (Stainless steel is virtually non-magnetic.)

The designers knew that the efficiency and power factor were bound to be low, but in this case even an efficiency of 10 per cent might be justified on the grounds that the pump had no moving parts to wear out so that maintenance could literally be nil. This was most important when the pump was to be used to remove heat from nuclear reactors where the metal was radioactively contaminated. A tubular form of pump was also developed. Tubular motors are easy to contruct because their primary winding consists only of a row of simple coils, but if there is a burn-out, it is necessary to break the pipeline in order to replace the winding, whereas the primary units of a double-sided flat machine can be removed without touching the pipe line. For this reason the flat machine was preferred.

The liquid metal pump was a clear example of an inefficient machine proving profitable in terms of overall economics. During the early part of this century efficiency was almost the only yardstick for the measure of machine quality. But there are fashions in engineering almost as there are in clothes and the most modern of such fashions often asks not so much the question, "How efficiently can it be done?" as, "Can it be done at all?" Thus one hardly asks what an instrument in an Apollo rocket costs; one only asks how reliable it is. At a less extreme level the present fashion in engineering is to examine the whole effect on the economics of a system before condemning a device as "inefficient." It is also worth noting that the very word "efficiency" has been much misused in the past by those who really meant "effectiveness," for the scientific meaning of efficiency is simply the ratio of power output to power input. One is not therefore over-concerned that the efficiency of a television set in less than 1 per cent! It is certainly a very **effective** device. Devices whose job is to produce force or pressure without movement have **zero** efficiency, but they can play most important roles in an engineering system. In modern economic assessment reliability, freedom from wear, absence of noise, absence of unwanted waste products are often given equal or greater consideration than power factor cost, efficiency and even power/weight ratio.



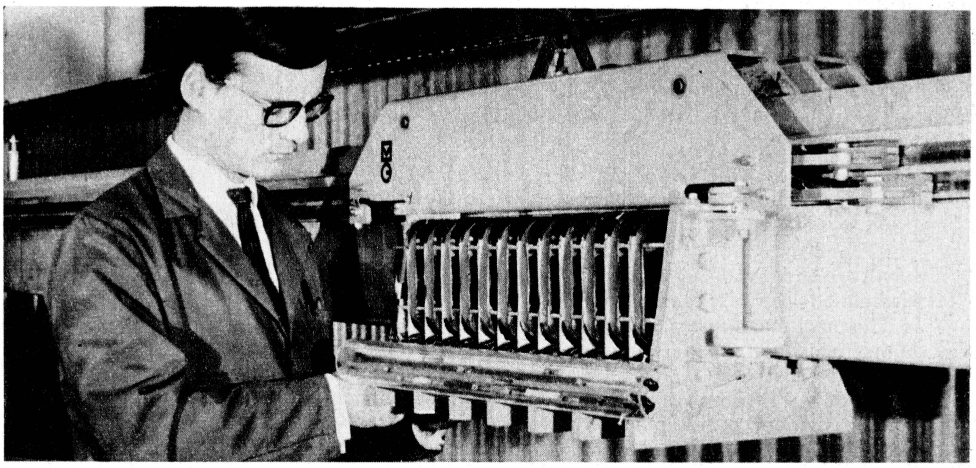
A model of a tracked air-cushion train propelled by linear motor, demonstrated in U.K. in 1966

Phase 2 of the development of linear motors did not depend on this change of fashion, however. It would have happened anyway, for it consisted of a number of academics (including the author) becoming intrigued with the fundamental mechanism of the linear motor and pursuing academic research on the device to the point where it became clear why the early motors had had such poor performance. In certain applications the research showed that highly efficient machines might be developed. In others it showed how to make the best of what was available (a daily problem in engineering).

Phase 2 occupied the period from 1950 to about 1965. Phase 3 began when industry took on the manufacture of linear motor units for a variety of purposes and it is the main purpose of this article to deal with this aspect of the subject.

It emerged during the academic phase that the applications of linear motors might be divided into three main classes:

(1) Machines required mainly for force production where the criteria of quality were force/weight, force/cost and force/unit of power input.



A linear motor, using the Gramme ring system, developed in France for the URBA railway system.

(2) Motors whose prime purpose was to produce kinetic energy. High values of energy/weight, energy/cost and energy efficiency are clearly required in this class.

(3) Power machines where the more conventional criteria of power/weight, power factor and efficiency apply.

The first class are usually termed "actuators" and are usually small machines. The academic research revealed that linear induction motors of all types required a minimum of about 40-50 watts of input for each pound of thrust at standstill. Where tons of thrust are required they could therefore not hope to compete with pneumatic or hydraulic actuators in terms of size, cost or power input. But where flexibility in project design was required, replacement of a hydraulic pipeline was not to be compared with a simple piece of flexible electric cable which would allow a unit to be moved at will. Nor does an electric actuator require a pump to be kept running even when the actuator is not actually being used and the maintenance on cables costs less than that on a high pressure piping system, to say nothing of the inconvenience of oil leaks in, for example, a parcel sorting system.

The second class can also be termed "accelerators." Machines in this class must produce both force and power, although neither commodity is in itself the designer's objective. The largest and, incidentally, one of the earliest commercially produced linear motors, was basically an accelerator and was used for assisting aircraft launching, called the Electropult. Built in the USA in 1946 by Westinghouse, it developed 10,000HP and accelerated an aircraft to a speed of 225 m.p.h.

Of necessity, the third class of machine consists entirely of high power, high speed motors for which the main application and surely the most exciting of all is that of high speed transport. Like the Westinghouse Electropult, it is usually profitable to mount the primary coil system on the vehicle even though this means that either a power unit must be carried on board or current must be supplied through brushes from ground feeders. The second member of the linear motor can then be simplified considerably compared with that of the conventional squirrel cage rotor, particularly in the case of a double-sided motor. Figure 2 shows an end view of such a machine. The rotor consists of a flat sheet of aluminium which is somewhat wider than the primary to allow the flow of return currents along the sides of the plate.

Improvements in the design of linear motors in all three classes are largely concerned with changes in shape. Tubular actuators have become popular because of simplicity of construction and the fact that the moving member may consist only of a copper coated steel rod, so that its replacement if the length of stroke of the actuator needs to be changed is cheap.

Accelerators, being intermediate between the "force" and "power" machines in almost all aspects can be of either moving primary or moving secondary types. One of the former type is installed at the Motor Industry Research Association Laboratories at Nuneaton and is used for crash testing vehicles and equipment. Just before impact the linear motor carriage is detached from the pay load, passes underneath the impact block and is stopped by mechanical arrester gear. The maximum speed of this accelerator is just over 30 m.p.h. and no attempt need therefore be made to control the field speed during the journey. But for higher speeds a graded field speed program might yield a sufficient increase in energy efficiency to warrant its cost. Field speed can be changed either by a change in supply frequency or by a change in primary winding pitch. With a moving primary system only the first of these is possible, but in a fixed primary machine the pole pitch can be increased progressively along the track. Research in this type of machine is continuing at Imperial College, London.

The application of linear motors to high speed transport systems has now virtually become an international competition and full-scale vehicles are being developed in the U.S.A., France, the U.S.S.R., Japan and Italy, as well

(Continued on page 189)

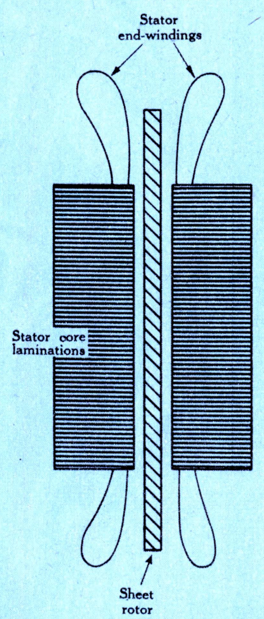


Figure 2. Cross section (end view) of a "sheet rotor" linear induction motor.

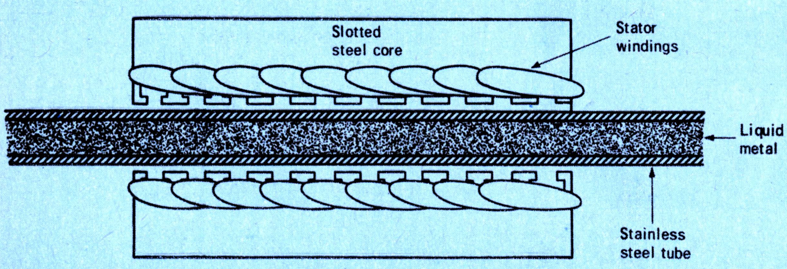
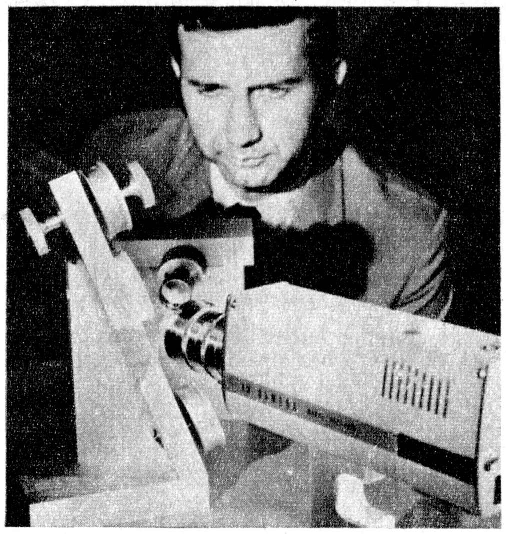


Figure 1. Simplified diagram showing a cross section through a liquid metal pump

COLOUR TV TAPES FOR HOME PLAYBACK



Inexpensive tapes made from thin plastic transparent film are used in a new recording system developed in the U.S.A. by RCA. The system will enable owners of colour television sets to build up a library of favourite programs, seen in full colour. The system is based on laser holography.

A laboratory set-up for demonstrating the colour tape system, with laser, transparent tape, and colour TV camera.

A laboratory model of the unit, described as a holographic colour-TV tape system, was demonstrated recently by RCA. They claim it as the first use of lasers and holography in a consumer product, and described it as the most significant development in home entertainment since the introduction of colour TV in the 1950s.

The system is intended to play back mass produced tapes, which RCA expect to make available for around $US10 each. The taped programs will cover a broad range of interests, such as sports, education, art, theatre, comedy, music, history, science, and many others. The system as demonstrated has no provision for making home recordings.

Basically, the playback system comprises a unit similar in appearance to a domestic sound tape recorder; and tape cassettes similar to the familiar recorded sound tape cassettes, but considerably larger. The tape player unit is connected to a standard colour TV receiver via the aerial terminals, and will supply the sound and vision signals for a colour TV program of about 30 minutes' duration. The signals are recorded on clear inexpensive plastic tape which costs only about one-tenth as much as conventional film or other recording media. The tapes are said to be scratch proof, dust proof and virtually indestructible under normal conditions of use, and a long playing life is predicted for them.

In addition to offering continued replay possibilities, they can be run in slow motion, can be stopped and started at will, and allow single frames to be examined at length.

Technical details of the system were given at a press conference by RCA scientists. At present, they explained, holographic tapes for the system are not made directly from life. Instead, they are made from colour movie films, videotapes, slides or photographs. They described the conversion process as follows:

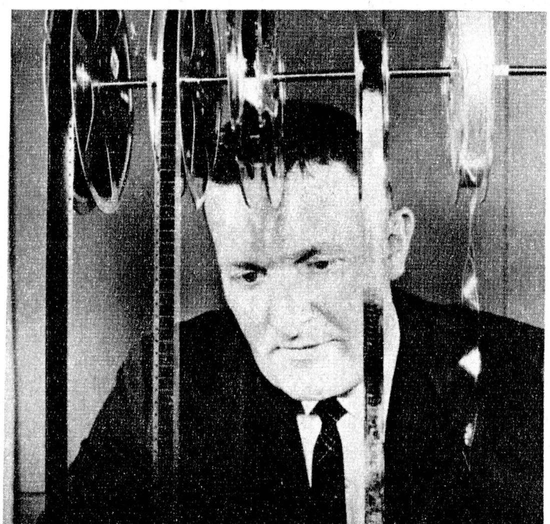
A colour program originating from a colour TV camera or colour video tape is first recorded on ordinary black and white film by means of an electron beam recorder (See page 25, this issue). The resulting film known as the colour encoded master, is then developed in the normal way, then converted by a laser to a series of holograms (optical interference patterns: see "Electronics Australia," August, 1966) recorded on a plastic tape coated with photoresist, a material that softens to varying degrees, depending on the intensity of light striking it.

Next, the tape is developed in a chemical solution that eats away the portions of the photoresist softened by the laser beam. The result is a relief map of photoresist whose hills and valleys, and the spacing between, represent the original colour TV program in coded form. This is called the hologram master.

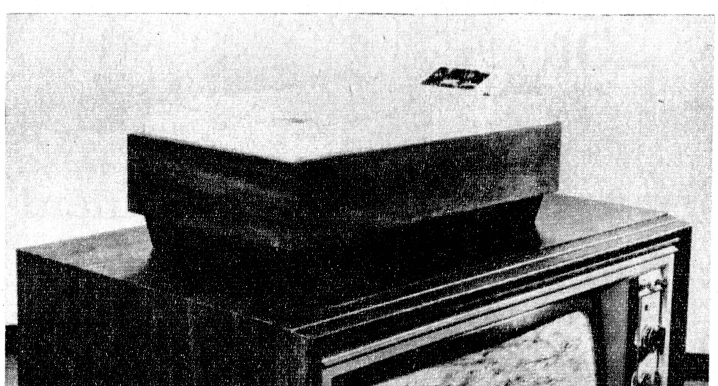
The hologram master is then plated with a thick coating of nickel and stripped away, leaving a nickel tape with the holograms impressed on it like a series of engravings. This is called the nickel master.

Finally, by feeding the nickel master through a set of pressure rollers along with a transparent vinyl tape of similar dimensions, the holographic engravings on the master are impressed on the smooth surface of the vinyl as holographic reliefs. The result is a holographic program tape, ready for home use. The nickel master can be used to press thousands of tapes this way without degradation.

Playback of such a tape requires only that the beam from a very low powered laser pass through it into a simple, low-cost TV camera which sees the images reconstructed by the laser directly, and their colours as coded variations in those images. The playback mechanism, the laser and the TV camera are all housed in the player unit.



LEFT: The five stages in the manufacture of the tapes. Left to right are (1) original colour film (2) electron beam colour encoded master film (3) holograph master (4) nickel master (5) program tape. BELOW: The compact playback unit sits easily on top of a normal colour TV receiver.

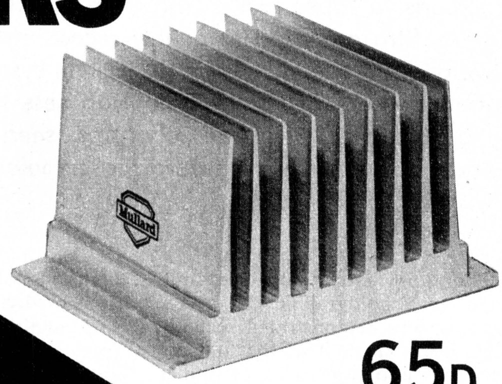


Standard extrusions for every purpose

Mullard heatsinks

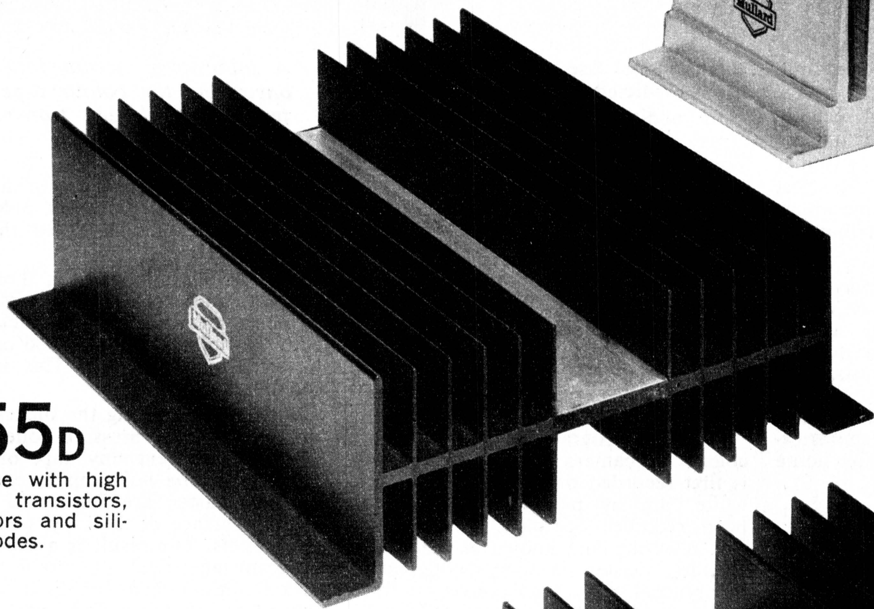
Manufactured in Australia, these extrusions offer design engineers "off the shelf" heatsinks for most applications.

TYPE	STANDARD LENGTHS	FINISH
35 D	2″ 3″ 4″ 6″	Anodised
45 D	3″ 4″ 6″	Anodised
55 D	4″ 6″ 8″	Anodised
65 D	4″ 6″ 8″	Plain



65D

For use with high power thyristors and silicon diodes under high peak current conditions.

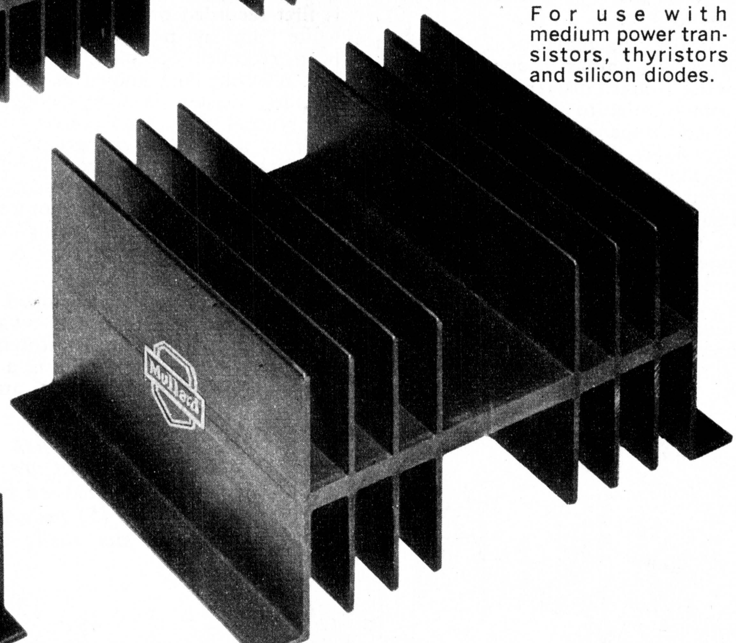


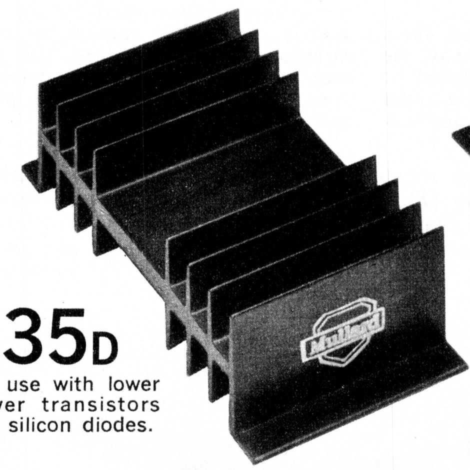
55D

For use with high power transistors, thyristors and silicon diodes.

45D

For use with medium power transistors, thyristors and silicon diodes.





35D

For use with lower power transistors and silicon diodes.

Bulk material is available in 36″ and 72″ lengths. Non-standard lengths, subject to quotation, can be supplied in minimum quantities of 100 pieces. **Further details are available from Mullard offices throughout the Commonwealth.**

Mullard

Mullard-Australia Pty. Ltd.

35-43 Clarence St., Sydney, N.S.W. 2000. Phone: 29 2006 ● 123-129 Victoria Pde., Collingwood, VIC. 3066. Phone: 41 6644 ● Cnr. Light St. and St. Paul's T'ce., Bowen Hills, QLD. 4006. Phone: 51 5151 ● 176 Wright St., Adelaide, 5000. Phone: 51 3123 ● 579 Murray St., Perth, W.A. 6000. Phone: 21 2561 ● Medhurst Wholesale Ltd., Hobart, Launceston, Burnie, TAS.

Associated with MULLARD LTD., LONDON

M235.

ELECTRON BEAM COLOUR RECORDER

A process to convert broadcast colour television signals to high quality 16mm colour film has been developed in the U.S.A. by the 3M Company.

The 3M "Chromabeam" system for converting NTSC colour video to 16mm motion picture film comprises an electron beam television recorder specifically designed for the system and a newly developed colour printer. The recorder embodies electronic components similar to those of the 3M EBR-100 Electron Beam Recorder which converts video signals into black and white photographic film (see "Electronics Australia," April, 1969) with the addition of a colour decoder and a colour field switcher. The encoded colour signal from either video tape or a TV camera is decoded into its separate red, green and blue components. These colour signals are then recorded on black and white film in a special field sequential colour format.

The colour components are fed into an electronic switcher which selects fields of each colour and provides an output of colour fields in a green-red-blue-green-red sequence. This colour sequence allows five colour separation images to be printed as two colour frames, permitting the conversion of the 60 field per second television rate to the 24 frames per second rate required for motion picture film.

A continuous motion film transport is employed in the EBR. This allows recording of 60 frames per second without lost time for film pulldown. The recording electron beam scans horizontally, and the film motion itself provides the vertical scan. The black and white colour separation film is processed after exposure by conventional developing methods.

After development, the separation film is loaded into a colour film printer, in which each frame of the colour film is exposed in sequence to the red, green and blue images from the black and white master film through appropriate colour filters. The printer employs a continuously rotating filter wheel and shutter, with intermittent film motion in both the projector and the camera. All components are driven in proper phase by a common drive motor.

In the printing sequence, the red, green and blue images are combined on one frame of the colour film. The blue is repeated with the following green and red separations for the next frame of the colour film. The sequence is repeated in that order. Conventional colour film processing follows.

Since the original separation recording may be done as either a negative or a positive, the colour film printed from the separation recording may be colour positive for direct projection or internegative for making multiple colour contact prints.

Australian 50 field/second colour video also may be recorded. Operation is very similar to 60 field/second recording, except the colour field sequence is green-red-green-blue.

Advantages claimed for the system, in addition to colour quality and cost, include:

1. The separation images allow independent control in the printing of all three colours, and thus automatically provide optimum colour balance and purity.
2. Because all separation images are on the same film, there is no indexing problem in printing, and any film shrinkage tends to be equal on all three colours.
3. The master black and white recording is archival, because it is not subject to dye colour fading.
4. Recording is done in real time, so it may be done live as well as from tape.
5. The separation master may be edited without upsetting the colour sequence by removing any multiple of five fields.

"This process will enable the television industry, for the first time, to economically convert its video taped program material on to colour photographic film without loss of colour quality and registration. This film can be projected on any standard 16mm projector and broadcast film chain equipment," said G. Nels Johnson, marketing manager for the company's Mincom facilities in Camarillo, California.

"The 'Chromabeam' system consistently provides a low-noise picture with colour registration and reproduction comparable to the taped or live original," he added. "The resolution is considerably better than that accomplished by other transfer methods. This system permits the television producer to combine the advantages of doing the original on video tape and then producing film copies for mass distribution," Johnson said.

"This process will make possible mass distribution of live or taped video program material to broadcast and cable television stations, educational institutions, churches, industrial training centres, advertisers and all other potential users of the material," Johnson pointed out. "Anyone with a standard 16mm projector can use it."

Delivery of the first production units is planned for late 1971. The system is expected to be priced at approximately $100,000.

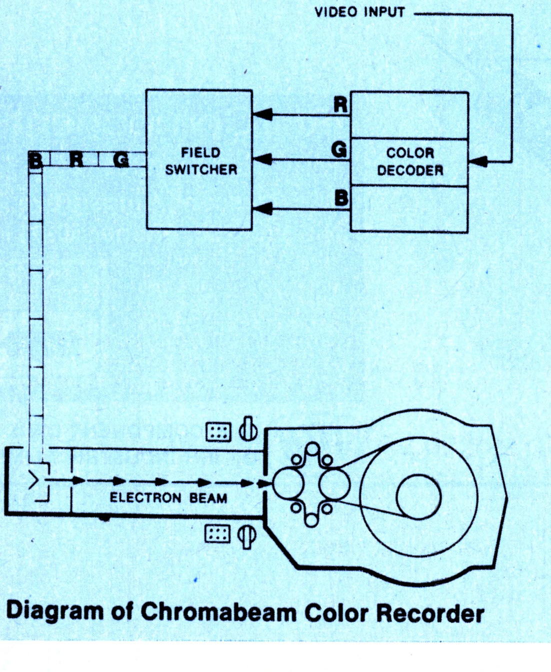


Diagram of Chromabeam Color Recorder

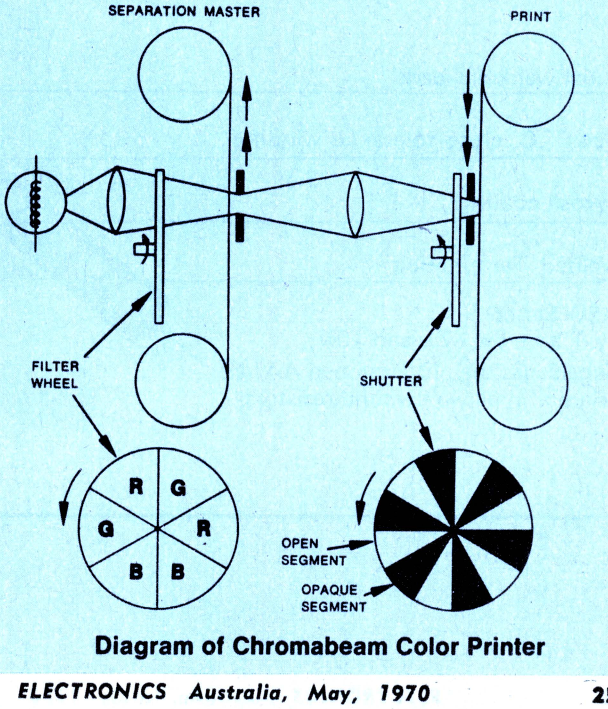
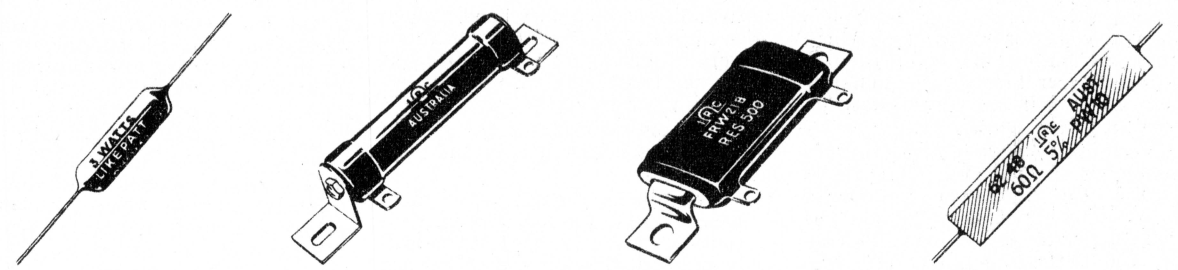


Diagram of Chromabeam Color Printer

It's a Now world!

Remember when you could only
have one type of wire wound resistor?

Now · you have the choice of FIVE styles



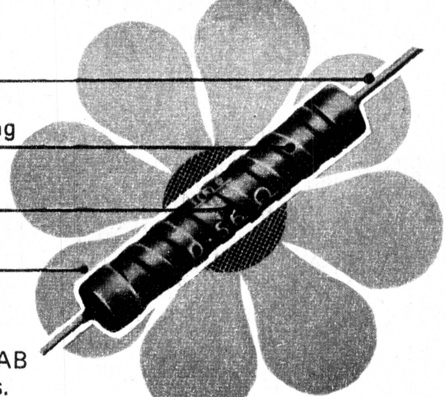
1. Vitreous coated Wire wound 1.5 to 14 watts.

2. Tubular, fixed and adjustable Wire wound 3 to 200 watts with "Pyrosil" coating.

3. Flat Wire wound with "Pyrosil" coating 20 to 75 watts.

4. Ceramic case Wire wound Fireproof inorganic construction 5 to 15 watts.

Now · another IRC AUSTRALIA first, NEW ASW SERIES



Axial weldable leads

Low T.C. close tolerance winding

Pyrosil coating

Welded Termination

ASW Series
1w - 2w - 5w - 7w and 10w
Supersedes the old fashioned AA/AB "Radio" type wire wound resistors.

IRH Components Pty. Limited
The Crescent, Kingsgrove, N.S.W. 2208. Phone: 50-0111

INTERSTATE TELEPHONES

MELB. VIC.	489.1088
HOB. TAS.	34.2811
LAUN. TAS.	22.844
PERTH W.A.	23.1971
ADEL. S.A.	8.2271
BRIS. QLD.	211933

IRH THE COMPONENT DIVISION OF IRH INDUSTRIES LIMITED

2227/R

TECHNICAL DIGEST

World's first iron deep-sea steamship is still sound

A problem arose last year when the British Government decided to tow the hulk of the historic steamship "Great Britain" back to the U.K. Would the 130-year-old metal plating be able to withstand the long sea voyage from the Falkland Islands?

The decade from 1840 to 1850 was a momentous one for British merchant shipping, which saw the foundations of Britain's later maritime dominance well and truly laid. A very strong individual influence was exercised by the steamship "Great Britain," one of the greatest ships ever built and perhaps supreme masterpiece of the shipbuilder Brunel. The first iron deep-sea steamship, the first propeller-driven one, the first ship with an elaborate watertight bulkhead system, an electric log, a balanced rudder — the "Great Britain" was completed in 1843.

After a long and eventful life, the ship was finally laid up as a hulk in the Falkland Islands in 1886. During her career she had been re-engined and had had her rig changed several times but overall she had proved an outstanding success and her structural design was completely satisfactory. When one remembers that no rules existed for building iron ships and that even a shipyard capable of building the ship had first to be constructed, this may be counted a real achievement.

"Great Britain" survived afloat until 1936 when she was put to rest in Sparrow Cove near Port Stanley in the Falkland Islands. She was beached in a sheltered place and then made tidal. Of late, interest has arisen in the possibility of bringing this historically extremely valuable hulk back to Britain. Before this could be considered, however, it was essential to obtain an idea of the ship's structural condition. It was not known whether or not the ship would be embedded in silt and it was thought that the sea bed might be very uneven which might have broken the ship up. These were factors easily checked but what was not easily checked was the thickness of the material. It would have been an enormous task to take direct thickness measurements all over the ship. In many cases this would have been impossible anyway as the ship had been sheathed in 1882 with 3-inch thick Green Heart timber from about 10ft below the waterline to about 10ft above. This sheathing is still in good condition and access, therefore, over much of the shell plating could only be from one side. As the sea is tidal access to the lower portion of the hull was not possible anyway except by visual diving inspection.

However, it is a characteristic of iron that it tends to remain in good condition under water and that the worst wastage is in areas between wind and water, that is along the waterline where there is abrasion, and exposure to wind and wave action.

It was soon concluded that an ultrasonic thickness gauge was what was required and the "Great Britain" Committee contacted Dawe Instruments Limited regarding the purchase of a Dawe Type 1806A Caliper gauge. This instrument appeared entirely satisfactory for a survey of the ship. On November 24, 1968, caliper measurements on the shell started.

Initial measurements, at tween deck level, were made. The plating inside the ship was very rusty and covered with thick scale. Very often so much had to be chipped away that the impression was gained that one was nearly through to the other side. However, once these thick layers of rust and scale had been removed, clean white iron surfaces were exposed and the Dawe Caliper showed that it could obtain thickness measurements without difficulty.

Measurements were taken right round the ship, many of them in way of the wood sheathing — in other words at the twixt wind and water level when the ship was afloat. Luckily the water levels inside the ship were low enough at low tide to give access to most of this structure. Generally speaking it was quite surprising to find that the bulk of the plating was only wasted by about 30 per cent or at the most 40 per cent of its original thickness, so that 60 per cent or 70 per cent of its original thickness was still there. Where plating had been 9/16 to 5/8in thick, there was still something of the order of 0.40in left. Generally speaking, in the parts where the plating is depended on for flotation, the Caliper showed that there is still 3/8in of iron, which is adequate.

A Dawe Type 1806 Sonoray caliper in use.

The Caliper was used on shell plating, side frames and deck beams, the last being found to be in excellent condition and virtually as new. Some of the web plates in the tween deck framing proved to be virtually the original thickness of 5/8in.

As a result of the use of the instrument, the Committee are now convinced that there is adequate material in the ship to permit her salvage and return home. ("Dawe Digest," Vol. 12, No. 2).

Pioneer lead the 'Pop' scene with the finest lead & bass guitar speakers

15'' Guitar Speaker P-382

Voice Coil Impedance:	8 Ohms (P382B) or 15 Ohms (P382A).
Nominal Power:	60 watt.
Frequency Response:	60 — 5000 c/s.
Sensitivity:	103 db/watt.

12'' Guitar Speaker 30-35Q

Voice Coil Impedance:	8 Ohms.
Nominal Power:	40 watt.
Frequency Response:	70/5000 c/s.
Sensitivity:	102 2 db/watt.

Contact your State Office of ASTRONICS AUSTRALASIA PTY. LTD. (Sole Australian Agents, and a member of the Electronic Industries Limited Group of Companies) for your nearest dealer's address.

VIC: 161-173 Sturt St, South Melb. Phone 69 0300.
N.S.W.: 121 Crown St, E. Sydney. Phone 31 6721.
S.A.: 81-97 Flinders St, Adelaide. Phone 23 4022.
W.A.: 28 Belmont Ave, Belmont. Phone 65 4199.
TAS: 199 Collins St, Hobart. Phone 2 2711.
QLD: 50-54 Lt. Edward St, Brisbane. Phone 2 0271.

PIONEER
– THE BIGGEST SOUND AROUND

DIGEST

JAGUAR — AN EXERCISE IN METRIC CONVERSION

When the British Aircraft Corporation in U.K. decided to go over to the metric system for a joint manufacturing venture with a French company, it led the rest of Britain in conversion to metric, since the official changeover had not come into effect. Their experience therefore proved a valuable guide to other companies subsequently obliged to follow the same course.

The British Aircraft Corporation is building Jaguar aircraft at its works in Preston, in the north of England. The Jaguar is an advanced trainer/light ground attack aircraft being developed jointly by France and Britain in several variants. Prototype aircraft are flying successfully and production has been initiated for the Armed Forces of both countries. It was originally designed to a French requirement and as such was conceived in metric terms. British participation in the venture introduced many changes, but the basic metric conception remained.

BAC Preston were therefore faced with two problems:

1. Which units to use in designing parts of the aircraft.

2. What effect there would be on their normal standards.

While it was appreciated that, in view of the national decision, the Jaguar presented a good opportunity to commence changeover to the metric system, these problems were further complicated by the time-scales for the design and construction of the first prototypes. The estimates for design times and the like did not contain any provision for possible delays due to a change to the metric system. After some discussions with the designers and draughtsmen, it was decided to take the risk and undertake all design and drafting in metric units. To assist manufacture, imperial conversions of the metric dimensions were shown in brackets, it being understood that in any case of dispute the ruling dimension would be the metric one. The French company also agreed to dual dimension their drawings.

This decision having been taken, a supply of metric scales was purchased and each draughtsman working on the project was issued with one. Around this period, the company was re-equipping the drawing office with new boards and drafting machines, and the opportunity was taken to install boards which would take the largest of the international "A" series drawing sizes and to provide dual inch/metric scales on the drafting machines. Initially this was confined to personnel on the Jaguar project, but the equipment is now universal in the drawing office.

During the period while the design was being finalised, the opportunity was taken to prepare instructions regarding tolerances and rounding of numbers. Booklets were issued covering inch/mm conversion, fits and limits and drill sizes. To enable work in the shops to commence with stock materials, charts were prepared showing the preferred metric sheet thicknesses and the nearest SWG. Tube suppliers were also given the range of metric tubes which would be required so that work in making and proving dies could proceed. A list was also prepared of the chemical and physical characteristics of French and British materials enabling a choice of comparable materials to be made.

In addition to this work, a comprehensive list of all the usual national and company standard parts was drawn up for discussion with the French company and comparison with their equivalent standards. The joint approach followed the general lines that where an ISO recommendation existed, both countries would work to this. In regard to units, it was agreed that BAC would use the SI units with the millimetre as the dimensional unit. Further, equipment suppliers were to be instructed that their data should be expressed in the SI units.

As a result of these discussions, BAC were able to agree to a set of standards in everything but threaded fasteners. They argued strongly for the use of their unified thread standards because of the degree of development which has been put into them and the fact that, outside the iron curtain, they are in world-wide use by all civil operators. They are also standard on the "Concorde" and obtainable from French manufacturers. As the argument looked like being a prolonged one, to save time it was mutually agreed that for the prototypes, each company would use their own standard fasteners and the marry-up areas would be mutually agreed in the light of technical requirements leaving the final decision to British and French officials.

This action was accepted by the officials who later confirmed that production aircraft would use inch unified thread fasteners.

In the final count, the change to metric units made no substantial difference to BAC's design estimates and the manufacture did not appear to suffer in any way. They had, however, to pay a little more for the dual standard plant and equipment, for the conversion of standards and for administration costs.

Since the initial efforts, some changes have taken place. BAC no longer put inch conversions on drawings of plate work, and all thicknesses are given in metric units using the ISO preferred range. Whereas in the early prototype days, all manufacture was done on imperial unit plant and equipment, this is now changing. As plant and equipment comes up for replacement, it is being replaced by dual or metric based equipment. It is also very noticeable that the personnel on the shop floor who have been fully engaged on the Jaguar project, now talk as glibly in metric terms as they once did in imperial units.

On the design side, the initial use of the metric system was confined to the geometric units which did not pose a great problem. For the technicians, stressmen and aerodynamicists who worked on the project, the problem was not only one of unfamiliar units, but also that of working to French regulations. To them and to the draughtsmen who have worked on the project, metric units are now second nature. BAC are now in process of introducing the coherent SI units as the basic working standard and design data sheets are being revised in terms of these units.

Involvement in metrication compelled BAC to look afresh to all their procedures and standards. As new ones arise and old ones are amended they are all being written in metric terms. Manufacturing processes are being treated in the same way. In fact, many of these were a mixture of imperial and metric units due to their being partly mechanical and partly chemical. The opportunity offered by the changeover has been taken to rationalise, and reduce the variety of standards.

The decision to take the plunge has shown that a number of the difficulties which appeared to be large when the problem was first examined have shrunk to much smaller dimensions, the adaptability of both works and design personnel being a case in point.

On current trends BAC estimate that by 1975, 76 per cent of production will be in metric units and the rate of plant equipment changeover is based on this. It is early yet to make a final prediction of the cost, but there are encouraging indications that it will be less than the original estimate. (Based on an article by T. C. Campbell, Head of Design Information Services, British Aircraft Corporation (Preston Division). Originally published in the U.K. Ministry of Technology's bulletin "New Technology," No. 27).

NOW-LOW COST, quality STEREO HI-FI for EVERYONE - from SONY®

COMPACT, PORTABLE —it's the 4-track TC-252

The popular priced new SONY TC-252 reproduces sound superbly, from a whisper to the boom of a big drum.

FEATURES • All silicon transistor ITL/OTL circuits—4-track stereo/mono tape recording and playback system • Retractable pinch roller for easy tape threading • Very compact • Operates either in vertical or horizontal position • Easy sound-on-sound recording—either right channel on left or left channel on right • Speaker switch for on/off and monitor-level control • Public address facility • High fidelity lid-integrated satellite speakers can be separated up to 16 feet for optimum stereo realism • 3 speeds: 7" reel capacity: dual VU meters: automatic shut-off switch: instant stop control • Easy frequency adaptation for your local line, 50 Hz or 60 Hz—only with a frequency selector and a removable capstan sleeve.

SPECIFICATIONS

Recording system: 4-track stereo/mono recording and playback. **Power requirements:** AC 240V, 50 Hz. **Power Consumption:** 45 watts. **3-tape speeds:** $7\frac{1}{2}$ i.p.s., $3\frac{3}{4}$ i.p.s., $1\frac{7}{8}$ i.p.s. **Reel capacity:** 7" or smaller. **Frequency response:** 30-18,000 Hz at $7\frac{1}{2}$ i.p.s., 30-13,000 Hz at $3\frac{3}{4}$ i.p.s. **Signal-to-noise ratio:** 50 dB. **Flutter and wow:** 0.12% at $7\frac{1}{2}$ i.p.s., 0.15% at $3\frac{3}{4}$ i.p.s., 0.2% at $1\frac{7}{8}$ i.p.s. **Harmonic distortion:** 3%. **Level indication:** dual VU meter. **Power output:** 12 watts, total dynamic power. **Recording time (1,800' tape):** stereo 6 hours at $1\frac{7}{8}$ i.p.s., mono 12 hours at $1\frac{7}{8}$ i.p.s. **Inputs (2):** microphone, sensitivity—72dB (0.19 mV), impedance 600 ohms. Auxiliary, sensitivity—26 dB (0.04V), impedance 100 k ohms. **Outputs (2):** line, output level—6 dB (0.39V), impedance 100k ohms. External speaker, impedance 8 ohms. Headphone (1), impedance 8 ohms. **Dimensions:** $16\frac{1}{8}$ (W) x $10\frac{1}{8}$ (H) x 15" (D) **Weight:** 28 lb. 13 oz.

SONY®

Distributed by:

JACOBY MITCHELL

SYDNEY—26 2651 • MELBOURNE—30 2491/2 • ADELAIDE—53 6117 • BRISBANE—2 6467 • PERTH—28 8102 • LAUNCESTON—2 5322 • Agents: CANBERRA—47 9010 • N'CLE—61 4991 • PORT KEMBLA—4 2071.

To: **Jacoby, Mitchell & Co. Pty. Ltd.**, 467-475 Kent St., Sydney, 2000.

Please send me information on the Sony TC-252 Stereo Tape Recorder.

NAME ....

ADDRESS ....

.... JMS/9-70 EA570

DIGEST

NEW TUBES PROMISE BRIGHTER FUTURE FOR COLOUR TV

Reports from the U.S.A. of continued progress in the design of colour TV tubes make encouraging reading for countries such as Australia, where colour TV is still to be inaugurated.

The newest development is the "black surround" or "black honeycomb." RCA last year announced their Hi-Lite Matrix tube, featuring an opaque black masking around each of the 1.2-million phosphor dots, for which they claim a 100 per cent increase in picture brightness. Zenith, who had been working on a similar "black surround" principle since 1960, quickly brought its Chromacolor tube to the fore. Most other picture tube manufacturers in the U.S.A., including G.E., Westinghouse, Motorola, Admiral and Sylvania, then rolled out their own "super bright" tubes, some using new, brighter phosphors, others the new black surround.

Black surround tubes prevent the picture from becoming "washed out" in brightly lit rooms. Ordinary levels of lighting in the domestic situation, whether natural daylight or artificial light, cause a sharp decrease in picture contrast, since the phosphors producing the picture image are themselves flooded with ambient light. This effect is diminished to some extent by the use of a neutral density filter in front of the tube face. Since ambient light when reflected has passed through the filter twice, while picture light passes through it only once, there is a 2:1 improvement in the ratio of ambient light to picture image light. In selecting filter density, manufacturers carefully balance transmissivity of the glass against the brightness available from the red, green and blue phosphor triads, for the best contrast and brightness obtainable.

The new technique developed by Zenith and others surrounds each phosphor dot with an opaque, jet-black material. Because this black material absorbs light instead of reflecting it, the neutral density of the glass used for tube front does not have to be so high. Zenith is now using 80 per cent transmission glass for its Chromacolor tubes, instead of the 42 per cent transmission glass formerly used. By using improved phosphors as well, they claim that the picture image obtained is 100 per cent brighter than with the old type tubes, and contrast is 25% better.

Another advantage is claimed for tubes with black surround. In these tubes, the screen area coated with phosphor material is 50 per cent less than the area coated in conventional tubes. Although only a proportion of each phosphor dot in the conventional tube is required to be illuminated, leaving a "guard band" not illuminated, large numbers of stray electrons strike the "guard band" and reduce image definition. In the new tubes, the black surround is not affected by these stray electrons, so image definition is improved. Also, light reflected from the front surface of the tube face is "killed" by the black surround.

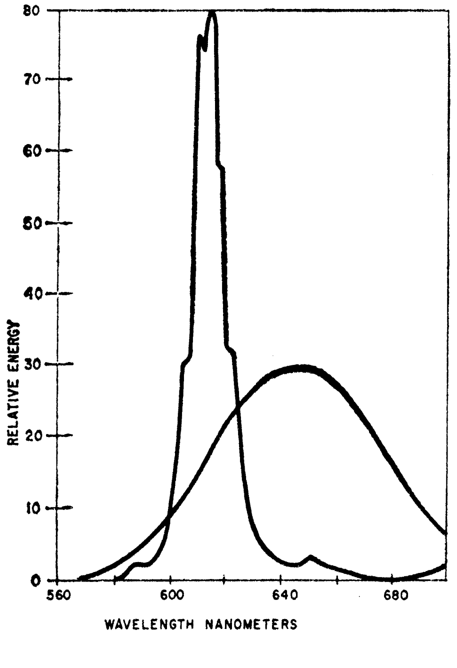
The arrangement of the phosphor dot triads in ordinary colour tubes is shown in figure 1a. The dots in each triad are tangential to each other, and the electron beam, its diameter fixed by the aperture in the shadow mask, excites only part of the dot area, leaving a circular guard band. This tolerance band is necessary for good white field colour purity. In the Chromacolor tube (figure 1b) the electron beam is wider than the phospher dots, but the spillover is only onto the black surround, so picture quality is not affected. However, as more area of phosphor is excited, there is an increase in brightness.

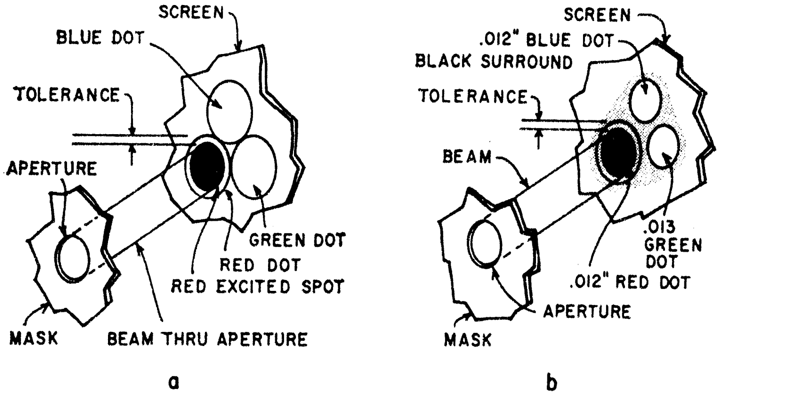
To accomplish this relative size of dots and beam, Zenith starts off with a shadow mask that has smaller holes than standard masks. The mask is used to screen 1.35 million dots on the screen of the picture tube. The holes are subsequently enlarged to permit electron beams larger than the dots to pass through. Now, instead of holding back the efficiency of some phosphors to keep beam currents equal, the dot diameters can be varied according to phosphor efficiency. Using some of the brightest phosphors available, Zenith deposits .012 red dots, .013 green dots and .012in blue dots.

It has been known for some time that rare earth phosphors radiate more light than the cheaper sulphide types. This is why manufacturers are still prepared to use them, even though they cost 10 to 15 times more than sulphide type phosphors. Figure 2 shows why. The high peaked curve represents light emitted from europium-activated yttrium orthovanadate, introduced as a red phosphor in 1964. The smaller, wider curve is that of silver activated zinc cadmium sulphide, widely used as a red phosphor before the rare earths became commercially available.

Although the peak of the sulphide material appears more in the red (longer) wavelengths, the vanadate appears redder to the eye. A larger proportion of the sulphide curve is in the shorter wavelengths, and the eye sees an orange-red. The vanadate phosphor appears brighter because most of the sulphide emission is in a region where the eye is least sensitive.

(Condensed from an article by John Mason in "Radio-Electronics," January, 1970.)





ABOVE: Figure 1. Diagram at left shows the conventional phosphor dot triad arrangement, used with a narrow electron beam which excites only part of each dot. At right is shown the arrangement with the black surround tubes, where a wider beam excites the entire dot area.

LEFT: Figure 2. The high peak represents the light emission against wavelength of a rare earth red phosphor. The lower hump is the response of a sulphide red phosphor.

SCIENTIFIC AND INDUSTRIAL NEWS

Elk-tracking by satellite

A wild, 500lb female elk has been fitted with a 23lb collar capable of transmitting information to the Nimbus-3 Satellite in an experiment to learn more about the migratory habits of large animals. The experiment, sponsored by NASA, the U.S. Department of Interior, and the Smithsonian Institute, began in February this year. The elk is one of 7,000 on the National Elk Refuge near Jackson Hole, Wyo. The collar contains a small antenna, transmitter, receiver, batteries and solar cells for recharging them. It is sealed against water and can withstand temperatures to 40 degrees below zero and a reasonable amount of shock.

A system aboard the Nimbus-3 weather satellite interrogates the collar twice daily, about noon and midnight, from its 700-mile altitude orbit. Data from the elk includes air and animal skin temperatures, altitude above sea level, light intensity, and location. This is stored in the spacecraft's memory to be matched with another interrogation two or three minutes later. From the time and range of the two consecutive interrogations, the location of the animal can be determined to within about one mile. In an earlier test, the collar was worn by a semi-tame elk in a seven-acre enclosure with no ill-effects on the elk.

Courses in South-East Asia

Twelve instructors from IBM Australia are conducting five different computing courses in South-East Asian countries this year as part of the company's assistance to smaller IBM operations in this area. The first course in this series was held in Djakarta and finished early in March. It covered computer programming and installation training at an intermediate level for students with some previous data processing experience. The same course will be repeated in Bangkok. A more basic class in programming, and several specialised schools are scheduled for Taipei.

The basic course, 12 weeks long, introduces university graduates to data processing and programming, with stress on attaining proficiency in computer language. The more specialised courses, lasting from two weeks, are at two levels —for data processing representatives, and for management. Attending the courses are approximately 100 students from Taiwan, Hong Kong, Singapore, Thailand, Indonesia, Malaysia, Korea, Vietnam, and the Philippines.

External heart monitor

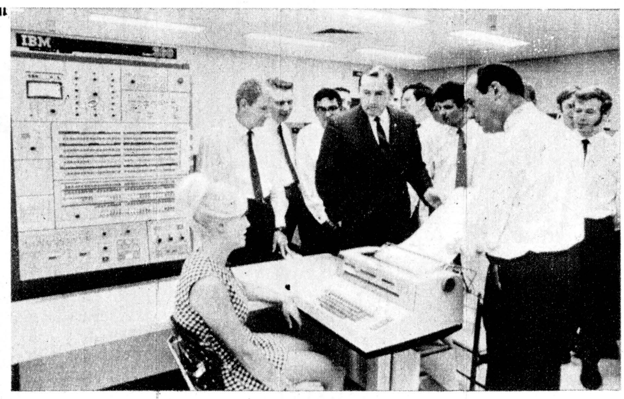
Scientists from the Stanford University School of Medicine and NASA's Ames Research Centre have successfully tested the application of ultrasonics to checking the functioning of the human heart. The tests provided information on the heartbeat and blood circulation previously obtainable only by passing a catheter into one of the heart chambers, and by taking X-rays and blood samples. Ultrasonic studies of the heart can be done by a well-trained person in the doctor's office or at the patient's bedside in a matter of minutes. The system can be applied as a screening procedure for patients with suspected heart disease and to monitor the healing process in patients recovering from heart surgery or from a heart attack.

Unlike standard monitoring devices, the ultrasonic system can measure precisely the amount of blood pumped out of the heart at each contraction of the heart muscle. It also measures the heart size, and can detect the backward flow of blood which indicates a defective heart valve. The recent tests used a commercially available machine to emit and receive the ultrasonic waves. Impulses were reflected from front and rear walls of the heart. They were then recorded and converted into electrical signals which were displayed on a cathode-ray tube. From the patterns of ultrasonic echoes, taken when the heart is relaxed and contracted, the researchers developed a formula enabling them to calculate precisely the volume of blood ejected by the heart, and also to determine the presence of abnormalities.

Nationwide data network

IBM Australia has announced an Australia-wide data processing network to be implemented in stages beginning in May. It will link remotely located computer terminals and small and medium computers to larger machines at IBM data centres in State capitals. By the end of 1970, users of small typewriter-like computer terminals, IBM 2741, anywhere in Australia will be switched through special telephone communication lines into the appropriate machine for the type of computing service required. In addition, IBM 1130 computers (the small and medium range of System/360 models), as well as the IBM 2770 and 2780 data communication systems, will be able to switch into the network for access to larger central machines for high speed batch processing of scientific and commercial applications.

From this month IBM terminal users in Sydney, Melbourne and Canberra have the option of selecting five different sets of programs (Math, Datatext, PL 1, Fortran, and Basic) by switching to either the Sydney or Melbourne data centre Model 50 computers. The service will operate at the same customer charge in each location irrespective of distance from the computer on-line to the terminal. (IBM Australia Ltd., IBM Centre, Bradfield Highway and Kent Streets, Sydney, 2000.)



Surrounded by programmers and systems engineers at the data centre in St. Kilda, Melbourne, the managing director of IBM Australia, Mr A. G. Moyes, inspects the results of a trail run of a new set of programs on the time-sharing IBM System/360 at the centre.

High-temperature plastic

A plastic material which can be fabricated like metal and is highly heat-resistant has been developed by the Carborundum Co. of the U.S.A. The plastic is known generically as a P-oxybenzonyl polymer and has been called Ekonol after its developer, Dr James Economy. Dr Economy, the company's research manager, said that "at temperatures of 800°F the new poymer begins to show a malleable behaviour similar to that of metals, enabling it to be fabricated by various conventional methods—high-energy forging, powder metallurgy, or plasma spray. An unexpected phenomenon was the combination of self-lubrication and its extreme rigidity."

Pilot production of the plastic has begun and large-scale production is scheduled to start in September. Carborundum expects that the initial cost of the plastic will be $35 (U.S.) per pound, dropping to about $15 (U.S.) for large orders after large-scale production begins.

Commercial broadcasting

Applications have been invited for the grant of a licence for a commercial broadcasting station at Gosford, N.S.W. The recent Australia/New Zealand agreement on frequencies has enabled the Australian Broadcasting Control Board to go ahead with plans for improving broadcasting services in some areas. The recommendation that a station be established at Gosford was a result of this planning and followed a comprehensive survey of the area. Applications will be the subject of a public inquiry by the A.B.C.B., which will publicise the place and date.

Plutonium studies

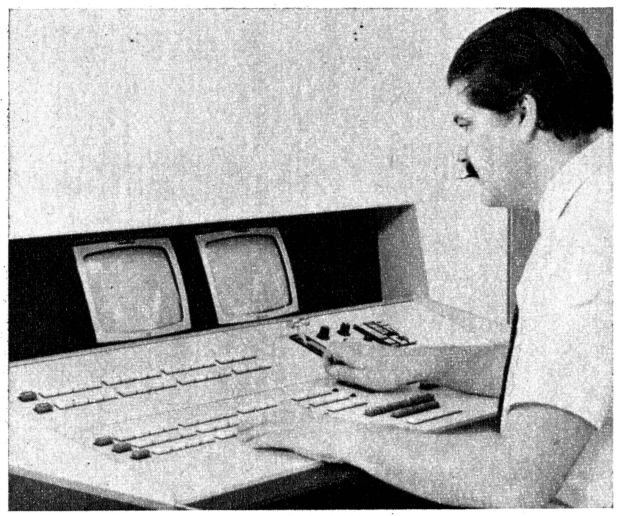
To study the use of plutonium in pressurised water reactor plants for producing electricity, the fuel assemblies at the San Onofre Nuclear Generating Station in California will soon be using plutonium. The study is being made because within the next few years a significant amount of plutonium will be produced by the operation of light water reactors in the U.S.A. While plutonium will best be used as fuel for fast-breeder reactors, such reactors are still under development and are not expected to require plutonium in large quantities until about 1980.

The broad purpose of the plutonium recycle program is to demonstrate the economic use of plutonium in large pressurised water reactors. The fabrication of 720 plutonium-bearing fuel rods has begun at Westinghouse's plutonium fuels development laboratory at Cheswick, Pa. The fuel rods, containing a mixed oxide of plutonium and uranium, will become part of the fuel assemblies to be used for the August, 1970, refuelling of the San Onofre Station. The plutonium fuel assemblies are to be part of the reactor's core for approximately four years. (Westinghouse News and Information Service, G.P.O. Box 3270, Sydney, 2001).

Cyclone survivor

A Plessey Rola sound column undamaged amid cyclone destruction on Hayman Island. A number of these columns formed part of the sound system installed on the island by Plessey Rola over ten years ago to provide background music and public address facilities. The column, consisting of 9ft poles on which are mounted special sound enclosures containing four 8" loudspeakers, came through the cyclone unscathed. The only damage to the sound installation was to an amplifier power transformer, which became waterlogged.

Computer-compatible switcher



A solid-state video switching unit, developed by the Ampex Corporation in the U.S.A., uses digital control logic for faster, more efficient operation and for easy adaptability to computer control for automated television stations. Known as the model VS600 switcher, it uses serially coded digital logic between control panel and an electronic rack matrix to greatly reduce interconnecting wires and to increase reliability and performance. It is designed for use in production studios or master control facilities by commercial and educational TV stations and networks.

West German satellite

In November, 1969, the first West German research satellite, Azur 1, was put into a polar elliptical orbit from the NASA rocket launching site in Vandenburg, California, with the aid of a Scout rocket. Its task is to investigate the inner Van Allen radiation belt, the polar light zone, and the solar particle streams occurring during solar eruptions. Siemens participated both in the creation of the satellite and in the construction of an efficient ground control system.

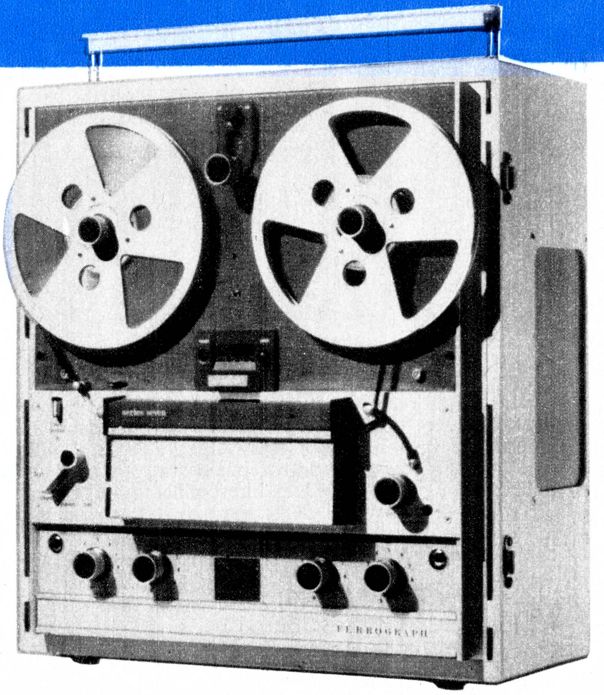
The ground control system has to ensure that all the scientific data sent from the satellite, together with information on the orbit and time, are made available to scientists as quickly as possible. It also has the task of maintaining the spacecraft's optimum operating condition at all times. The heart of the control system is the satellite control centre in Upper Bavaria. It is run by the German experimental research institute for air and space travel. (Siemens Industries Ltd., 544 Church Street, Richmond, Vic. 3121.)

Temperature symposium

The 5th Symposium on Temperature, its Measurement and Control in Science and Industry, will be held in Washington, D.C., U.S.A., from June 21 to 24, 1971. Some of the technological areas of thermometry that will be developed at the Symposium include: temperature scales, radiation pyrometry, resistance thermometry, thermocouples, magnetic or quantum electronic thermometry, potentiometers and bridges, automated measurements, geophysical and space biological special thermometric devices, and temperature controls.

Prospective authors are invited to submit abstracts for consideration by January 4, 1971. Full manuscripts must be received not later than May 1, 1971. Further information is available from Vincent J. Giardine, Instrument Society of America, 530 William Penn Place, Pittsburgh, Pa. 15219, U.S.A.

Ferrograph P715 H
Full Track Monophonic Professional Tape Recorders



Designed in collaboration with, and used by the B.B.C. and I.T.V. (London's Commercial T.V.). The P715 series exceed Australian Broadcast Control Board Specifications in all respects.

BRIEF SPECIFICATIONS:

Frequency Response

3¾ i.p.s.	3dB 50Hz—12kHz
7½ i.p.s.	2dB 40Hz—17kHz
15 i.p.s.	2dB 30Hz—20kHz

Equalization (I.E.C.):

3¾ i.p.s. 90/3180 microseconds.
7½ i.p.s. 70 microseconds.
15 i.p.s. 35 microseconds.

Signal to Noise Ratio

Reference 2% distortion:

7½ i.p.s. better than	55dB unweighted. 64dB weighted.
15 i.p.s. better than	55dB unweighted. 60dB weighted.

Wow and Flutter

3¾ i.p.s. Less than 0·12%
7½ i.p.s. Less than 0·10%
15 i.p.s. Less than 0·08%

Price P715H $824.00 Plus Sales Tax. Full details available from all authorized Ferrograph Dealers.

SOLE AUSTRALIAN DISTRIBUTORS

Leroya Industries PTY. LTD.

266 Hay Street, SUBIACO, W. AUST. 6008

SEVENTH SI BASE UNIT

The 1969 meeting of the International Committee for Weights and Measures (Comite International des Poids et Mesures — CIPM) was held in Paris from October 7 to 9.

The CIPM, composed of 18 individuals each from a different country, is responsible for the operation of the International Bureau of Weights and Measures and, through its seven consultative committees, proposes to the General Conference on Weights and Measures (Conference Generale des Poids et Mesures—CGPM) measures for consideration by that body. Each nation adhering to the Treaty of the Metre is represented at CGPM meetings.

At the 1969 meeting, the CIPM accepted (and will submit to the CGPM for approval at the 1971 meeting) several actions of the Advisory Committee on Units (Comite Consultatif des Unites—CCU). One of the CCU proposals is that a seventh base unit, the mole, be added to the International System of Units (SI). An interim translation of the text is:

"1. The mole is the amount of substance in a system containing as many elementary entities as there are atoms in 0.012 kilograms of carbon 12; Its symbol is mol. 2. When one uses the mole, the elementary entities ought to be specified and can be atoms, molecules, ions, electrons, other particles, or specified groups of such particles. 3. The mole is a base unit of the International System of Units."

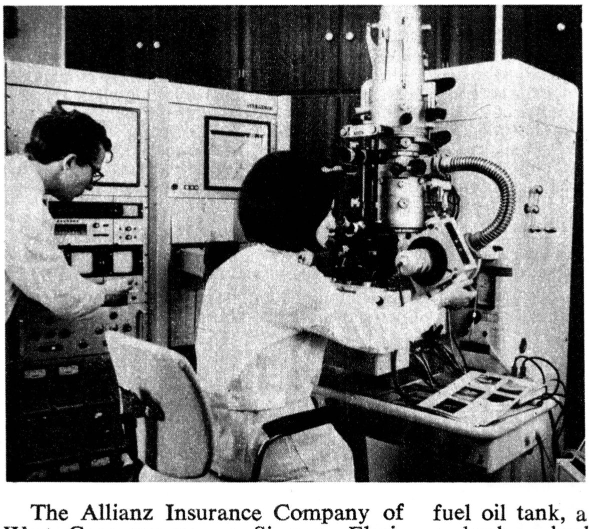
Also recommended by the CCU were actions to add to SI the name siemens, symbol S, for the unit of conductance and the pascal, symbol Pa, as a short name for the newton per square metre (unit of pressure and stress). (See also "Electronics Australia," April, 1970, page 40.)

CIPM recognised the need for greater international co-operation in the field of standard reference materials. These materials, of known physical property or chemical composition, are widely used for on-site calibration of instruments. A preparatory committee was established for the initiation of a standard reference material program.

As it is impossible to specify the time of day as accurately as the second is defined and realised, the CIPM agreed to examine the requirements for epoch and simultaneity. The basic problem is to define a unified time scale that meets the requirements not only of physicists and engineers but also of navigators and astronomers.

The CIPM agreed to add its name to the list of sponsors of the International Conference on Precision Measurement and Fundamental Constants to be held at the U.S. National Bureau of Standards in August, 1970. The objective of the conference is to discuss modern techniques of precision measurements and their application, along with modern theoretical development, to the determination of the fundamental constants. Further information is available from the National Bureau of Standards, Office of Technical Information and Publications, Washington, D.C. 20402, U.S.A.

Electron microscope aids damage research



The Siemens Elmiskop electron microscope at the Allianz Insurance Company's test centre in Munich.

The Allianz Insurance Company of West Germany uses a Siemens Elmiskop, a high-performance electron microscope, in conjunction with a microprobe to carry out damage research. Researchers at the company's test centre in Munich determine the cause of damage in particular cases and work out suggestions for averting such damage in the future. Objects examined include a corroded fuel oil tank, a damaged turbine blade, a broken brake drum, and a large chemical plant which had been forced to close down. In addition to the electron microscope, the research workers use a Siemens Elmisonde electron probe microanalyser which determines the structure of the material of the test piece in full detail. (Siemens Industries Ltd., 544 Church Street, Richmond, Vic. 3121.)

Large-screen television

A television projection unit, using the well-known Schmidt optical system, has been produced by the French company, Electronique Marcel Dassault. Called the Telemegascope, it enables standard TV pictures to be projected on to a large screen. The equipment can be associated with any type of peripheral unit, such as a TV

receiver, camera, video recorder, etc. The projection tube is cooled without external air inputs to avoid electrostatic dust precipitation on the CRT screen. The control unit, located beneath the projector, supplies the latter with low and high voltages and with scanning currents. The projector contains the deflector coils and video amplifier.

The system uses transistors, printed circuits and plug-in modules for easy servicing and maintenance, and for greater reliability. The Telemegascope is extremely simple to operate. (Electronique Marcel Dassault, 55 Quai Carnot, 92 Saint-Cloud, France.)

Telecommunication Day

In order to make the general public aware of the importance of contemporary problems in telecommunications, the member countries of the International Telecommunication Union (ITU) will hold the second World Telecommunication Day on May 17, 1970. The theme will be "Telecommunications and Education" in view of the fact that the United Nations has declared 1970 to be "Education Year." Many member countries are preparing to celebrate this day from the twofold aspect of the utilisation of telecommunications media for education purposes and the teaching of telecommunications subjects.

Business efficiency fair

The Office Equipment Industry Association of Australia (South Australia Division) is to hold a business efficiency fair in the Royal Agricultural and Horticultural Society Showgrounds, Wayville, S.A., from 18 to 22 May, 1970. Office equipment, modern aids to efficient management, and the latest business control equipment will be displayed, including many items designed and manufactured overseas. The fair is being organised by Riddell Exhibition Promotions Pty. Ltd., 618 St. Kilda Road, Melbourne, 3004.

IF YOU REALLY VALUE YOUR RECORDS

DON'T UNDERRATE THE GRAM!

(. . . a commentary on the critical role of tracking forces in evaluating trackability and trackability claims)

TRACKABILITY:

The "secret" of High Trackability is to enable the stylus tip to follow the hyper-complex record groove up to and beyond the theoretical cutting limits of modern recordings—not only at select and discrete frequencies, but across the entire audible spectrum—and at *light tracking forces that are below both the threshold of audible record wear and excessive stylus tip wear.*

The key parameter is *"AT LIGHT TRACKING FORCES!"*

A general rule covering trackability is: the higher the tracking force, the greater the ability of the stylus to stay in the groove. Unfortunately, at higher forces you are trading trackability for *trouble.* At a glance, the difference between ¾ gram and 1, 1½, or 2 grams may not appear significant. You could not possibly detect the difference by touch. *But your record can! And so can the stylus!*

TRACKING FORCES:

Perhaps it will help your visualization of the forces involved to translate "grams" to actual pounds per square inch of pressure on the record groove. For example, using ¾ gram of force as a reference (with a .2 mil x .7 mil radius elliptical stylus) means that 60,000 lbs. (30 tons) per square inch is the resultant pressure on the groove walls. At one gram, this increases to 66,000 lbs. per square inch, an increase of *three tons* per square inch—and at 1½ grams, the force rises to 75,000 lbs. per square inch, an increase of *7½ tons* per square inch. At two grams, or 83,000 lbs. per square inch, *11½ tons* per square inch have been added over the ¾ gram force. At 2½ grams, or 88,000 lbs. per square inch, a whopping *14 tons* per square inch have been added!

The table below indicates the tracking force in grams and pounds, ranging from ¾ gram to 2½ grams—plus their respective resultant pressures in pounds per square inch.

TRACKING FORCE		GROOVE WALL PRESSURE
GRAMS	POUNDS	POUNDS PER SQUARE INCH
		(See Note No. 1)
¾	.0017	60,000
1	.0022	66,000 +10% (over ¾ gram)
1½	.0033	75,000 +25% (over ¾ gram)
2	.0044	83,000 +38% (over ¾ gram)
2½	.0055	88,000 +47% (over ¾ gram)

SPECIAL NOTE:

The Shure V-15 Type II "Super-Track" Cartridge is capable of tracking the majority of records at ¾ gram; however state-of-the-art advances in the recording industry have brought about a growing number of records which require 1 gram tracking force in order to fully capture the expanded dynamic range of the recorded material. (¾ gram tracking requires not only a *cartridge* capable of effectively tracking at ¾ gram, but also a high quality manual *arm* [such as the Shure-SME] or a high quality automatic turntable *arm* capable of tracking at ¾ gram.)

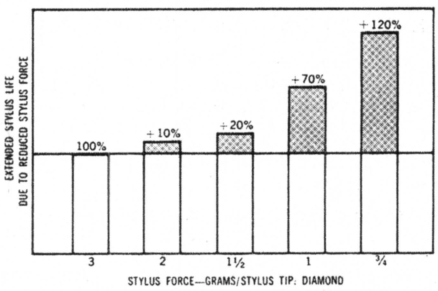
TESTS:

Our tests, and the tests of many independent authorities (see Note No. 2), have indicated two main points:

A. At tracking forces over 2 or 2½ grams, vinylite record wear is dramatically increased. Much of the "high fidelity" is shaved off of the record groove walls at both high and low ends *after a relatively few playings.*

B. At tracking forces over 1½ grams, *stylus wear is increased to a marked degree.* When the stylus is worn, the chisel-like edges not only damage the record grooves—but tracing distortion over 3000 Hz by a worn stylus on a brand new record is so gross that many instrumental sounds become a burlesque of themselves. Also, styli replacements are required much more frequently. *The chart below indicates how stylus tip life increased exponentially between 1½ and ¾ grams*—and this substantial increase in stylus life significantly extends the life of your records.

RELATIVE AVERAGE TIP LIFE VS. TRACKING FORCE



No cartridge that we have tested (and we have repeatedly tested random off-the-dealer-shelf samples of all makes and many models of cartridges) can equal the Shure V-15 Type II in fulfilling all of the requirements of a High Trackability cartridge—both *initially* and after *prolonged* testing, especially at *record-and-stylus saving low tracking forces.* In fact, our next-to-best cartridges—the lower cost M91 Series—are comparable to, or superior to, any other cartridge tested in meeting all these trackability requirements, regardless of price.

NOTES:

1. From calculations for an elliptical stylus with .2 mil x .7 mil radius contact points, using the Hertzian equation for indentors.
2. See HiFi/Stereo Review, October 1968; High Fidelity, November 1968; Shure has conducted over 10,000 hours of wear tests.

SHURE

V-15 TYPE II

SUPER-TRACK HIGH FIDELITY PHONOGRAPH CARTRIDGE

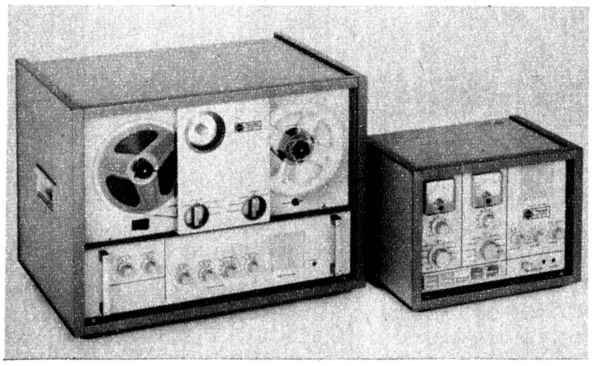
For further information contact the Australian Distributors

AUDIO ENGINEERS PTY. LTD.

342 KENT STREET, SYDNEY, 2000. TELEPHONE 29 6731

AE 010/102

Plessey recorder for Royal Australian Navy



The Plessey SR421 tape recorder system, designed for specialised R.A.N. applications.

A magnetic tape recorder system, the Plessey model SR421, has been designed and manufactured in Australia to meet the R.A.N. service requirements in specialised communication and instrumentation applications. The system comprises a local unit with tape transport and all operating facilities and a remote unit that allows complete control from any remote point. The SR421 is a two-channel four-speed recorder built for full reliability under extreme operational and environmental conditions.

The direct-drive printed-circuit capstan motor has extremely low intertia, and is capable of nearly instantaneous speed changes. Each of the four speeds is selected and controlled electronically, and there are no belts, pulleys or gears to influence the tape speed accuracy. Closed-loop servo control of the tape speed can be effected with an optional adaptor unit suited for synchronisation with film or facsimile recording. The recorder is not dependent on mains frequency for tape speed accuracy. Audio inputs include six high-level lines, two low-impedance microphone inputs and one high-impedance input. Any signal can be recorded on either or both channels, and an internal 1KHz reference signal can be selected on one channel. The overall frequency response at 15ips is better than 40Hz to 30KHz plus or minus 3dB.

Recorded announcements

The Indian - Pacific passenger trains, which operate over the 2,461-mile run from Sydney to Perth, are equipped with Plessey Electronics CT80 cartridge recorders. A unit is fitted in the first-class lounge car, and provides recorded background music in all parts of the train. It is also used to make welcoming announcements to passengers boarding the train and to announce meal arrangements during the journey. All announcements are pre-recorded at the Commonwealth Railways depot in Port Augusta, S.A. The CT80 is also used on the trains operating between Port Pirie and Perth.

Hydrogen round comet

A large hydrogen cloud has been discovered surrounding the comet Tago-Sato-Kosaka. The cloud was detected by instruments aboard NASA's Orbiting Astronomical Observatory 2 (OAO 2). The instruments first locked on to the comet on January 14, 1970 as it moved away from the sun. The hydrogen was detected by its radiation in the far ultraviolet regions of the spectrum. This radiation, called Lyman alpha radiation, does not penetrate the earth's atmosphere, so that astronomers previously had to observe radiation from other, less abundant, elements, such as carbon. Preliminary data indicated that the glowing cloud of hydrogen surrounding the head of the comet is as large as the sun itself.

HCl hazard in fires

A recent study at the U.S. National Bureau of Standards has shown that when polyvinyl chloride (PVC) wire insulation is heated it goes through two stages of decomposition. In the initial phase, when the level of heat input is relatively low, a white mist of hydrochloric acid (HCl) is generated. In the later phase, when the material is exposed to higher levels of heat input or to an open flame, a dark sooty smoke is released.

The release of the HCl prior to the development of dense smoke presents a potentially hazardous situation, especially for fire-fighting personnel. The HCl is colourless, but forms a white mist resembling steam by combining with moisture in the air. Although innocuous in appearance, the HCl acts as a primary irritant and corrosive agent to the respiratory system.

Transmitters for T.P.N.G.

Acting on behalf of the Papua and New Guinea Posts and Telegraph Department and the National Broadcasting Service, the Australian Post Office has ordered 10 2KW broadcast transmitters from Amalgamated Wireless (A'asia) Ltd. Some of the equipment is to replace existing installations in the National Broadcasting Service, and some is to establish a new broadcasting network in the Territory. Six HF transmitters are to be installed at Madang, Goroka, Lae, Mount Hagen, Kerema and Port Moresby. Four MF transmitters are to be installed at Madang, Goroka, Lae and Wewak. Deliveries are due to begin in August.

A low cost 70MHz Digital Frequency Meter

Here is the high frequency version of our new digital counter design, which uses basically the same counting and input circuitry as the 200KHz instrument described in the March issue. In the new instrument the counter gating signals are provided by a quartz crystal timebase system, the outputs of which are also made available externally for the frequency calibration of receivers.

by Jamieson Rowe

The 70MHz digital counter-frequency meter to be described in this article takes advantage of recent developments in components and circuit techniques to provide a standard of performance normally found only in commercial instruments involving a much higher cost. It provides the facility for making rapid, unambiguous and highly accurate measurements of frequency and time period, together with the facility for performing convenient and reliable counting of events.

Because of the high performance/cost ratio offered by the instrument, it should be very suitable for use in equipment servicing, production testing, and research and development laboratories. It should also be of particular interest among amateur radio operators, by virtue of the fact that its frequency range not only covers the entire HF spectrum, but also extends to cover both the 52-54MHz VHF band and the first sub-multiple of the 144MHz band at 72-74MHz.

The fact that its frequency range extends beyond 70MHz may also make the instrument of value in the development and/or servicing of VHF mobile radio equipment operating in the 70-85MHz bands.

It may also be of interest to universities and technical colleges, both as a means of providing low-cost digital frequency meters for student use, and also as a constructional project for engineering and science students. The design would be well suited for the latter application, as it combines low cost and ease of construction with the use of modern integrated microcircuits and printed wiring boards.

The design uses solid-state devices throughout, with the exception of the gas-discharge tubes used for numerical readout display. It uses a total of 43 microcircuits, 8 discrete transistors, 7 diodes and a silicon rectifier bridge. The digital microcircuits used include devices of the RTL, DTL and ECL variety, and together represent some 799 functional transistor elements and 47 functional diode elements. This may give some idea of the order of wiring simplification and cost reduction which has been made possible with microcircuits.

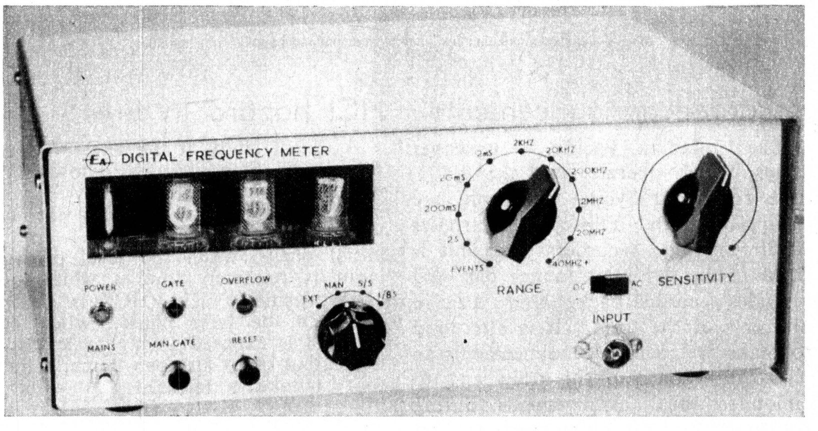
The instrument has a counter consisting of three full decades plus single digit over-range, and is also fitted with overflow detection and indication. The readout display is via side-viewing, gas-discharge display tubes for the full decades, together with a matching neon lamp for the over-range "1." Counter capacity is 1,999, giving a display resolution of .05 per cent.

Six frequency measurement ranges are provided, together with four time period ranges and an "events counting" range. The frequency ranges are nominally 0-2KHz, 0-20KHz, 0-200KHz, 0-2MHz, 0-20MHz, and 0-70MHz. The time period ranges are nominally 0-2mS, 0-20mS, 0-200mS and 0-2S.

Gating signals for the frequency ranges, and clock signals for the time period ranges, are derived from an internal timebase system which consists of a quartz crystal oscillator and a decade divider chain. The oscillator uses a low-cost 2MHz crystal, which although not operated at constant temperature should give a frequency stability approaching 1 part in 100,000.

As the accuracy of a digital frequency meter is largely determined by the timebase, this means that the overall accuracy of the new instrument can in theory approach .001 per cent. To enable this performance to be realised as closely as possible, a frequency vernier trimmer has been included in the crystal oscillator, and a 1MHz signal derived from the oscillator is made available at a rear-panel connector for comparison with a standard reference signal.

By using a convenient communica-



SPECIFICATIONS

A low cost digital frequency meter employing integrated microcircuits and gas-discharge readout tubes. The readout display provides three full decades plus single digit over-range, but digits of lower significance than those normally displayed may be viewed by deliberate down-ranging and counter overflow. Overflow is indicated by means of a panel lamp.

The frequency measurement range of the instrument, using internal timebase signals, extends to beyond 70MHz with a resolution of 1Hz. Time period measurements may also be performed using internal clock pulses, the capacity of the instrument being 2S with a resolution of 1uS.

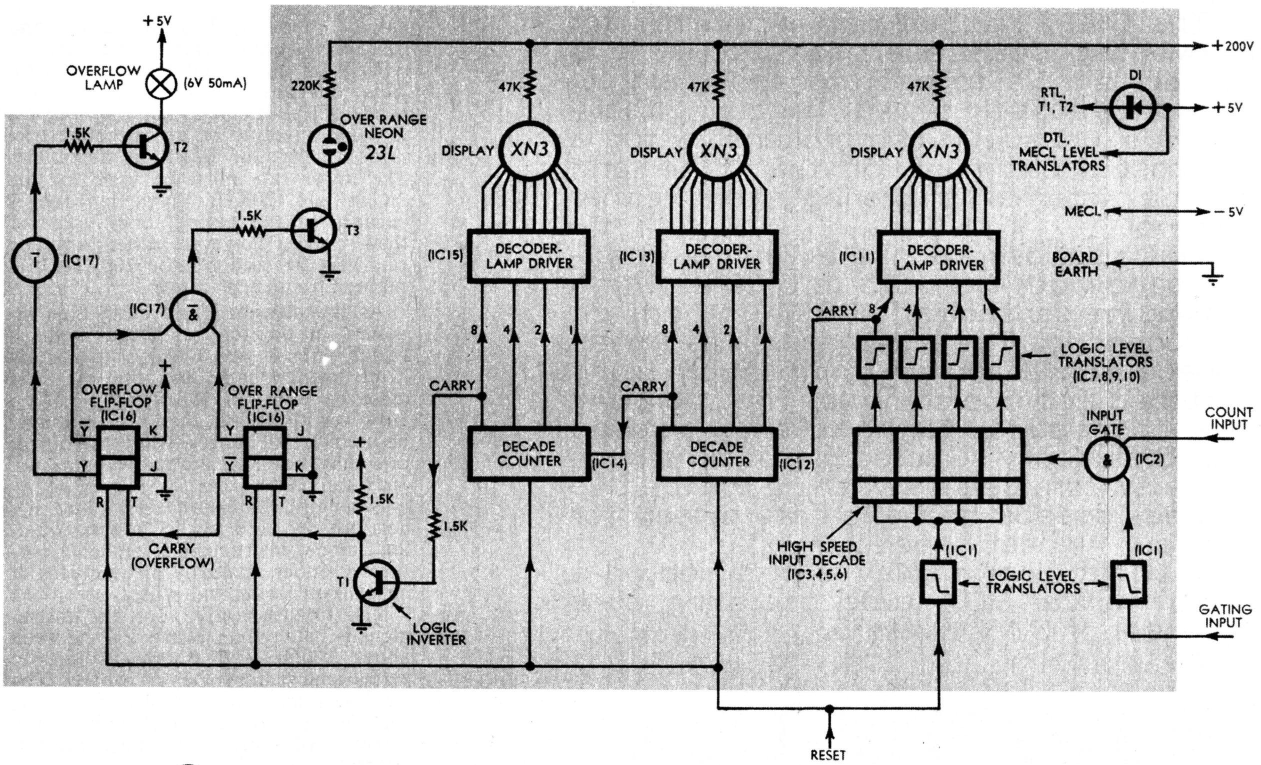
The timebase/clock signals used for frequency and time period measurements are derived from a quartz crystal oscillator and divider chain. Many of the timebase/clock frequencies are made available at a connector on the rear panel of the instrument, for use in receiver calibration, digital circuit testing, and as frequency marker signals for sweep alignment.

There are six frequency ranges, with capacities of 2KHz, 20KHz, 200KHz, 2MHz, 20MHz and 70MHz + respectively. Time period measurements may be performed using four ranges, whose capacities are 2mS, 20mS, 200mS and 2S respectively. An "events" range permits manual control of the counter gate for event counting.

Two internal sampling rates are provided, 5 per second and 1 per 8 seconds, together with a manual sampling facility and also a provision for external command sampling (+3V/0V logic convention).

Input impedance of the instrument is approximately 2K ohms, with an input sensitivity of approximately 30mV P-P up to 2MHz, rising to better than 600mV P-P at 70MHz. The input sensitivity is adjustable and the input circuitry is protected from overload damage for inputs up to 100V peak-to-peak.

Power consumption of the instrument is approximately 45 watts.



DIGITAL FREQUENCY METER — COUNTER BOARD

Figure 1

GREY OVERPRINT INDICATES PRINTED WIRING BOARD (69/d10)

tions or short-wave receiver, the instrument may thus be calibrated against standard frequency transmissions such as those from the NBS stations WWV and WWVH, or those from the Australian P.M.G.'s Department station VNG. And although the stability of the crystal oscillator should for most purposes make it unnecessary, this calibration procedure may even be performed during normal operation of the instrument.

Naturally the same 1MHz signal output of the instrument may also be used as a reference signal for use in receiver calibration, etc. To further assist in this type of application, the gating/clock signals used for each of the frequency and time period ranges are also made available for external use, via a second rear-panel connector.

The frequency response of the instrument in the frequency measurement mode should be typically in excess of 70MHz; the prototype instrument is useful to beyond 76MHz. This performance has been achieved despite the basic 40MHz capability of the counting section of the instrument, by means of a novel internal 2:1 scaling system.

In the time period measurement mode the maximum resolution is 1uS, while direct input coupling permits measurements down to very low frequencies.

In the "events count" mode the instrument will perform normal counting, the gate being controlled by a manual pushbutton on the front panel. An indicator lamp is provided to display the "gate open" condition. The logic circuitry is arranged so that the first depression of the button following instrument reset will open the gate, while the second depression will close it. Further depressions have no effect until the instrument is reset, ensuring that readings are quite unambiguous. The input pulses counted in this mode may

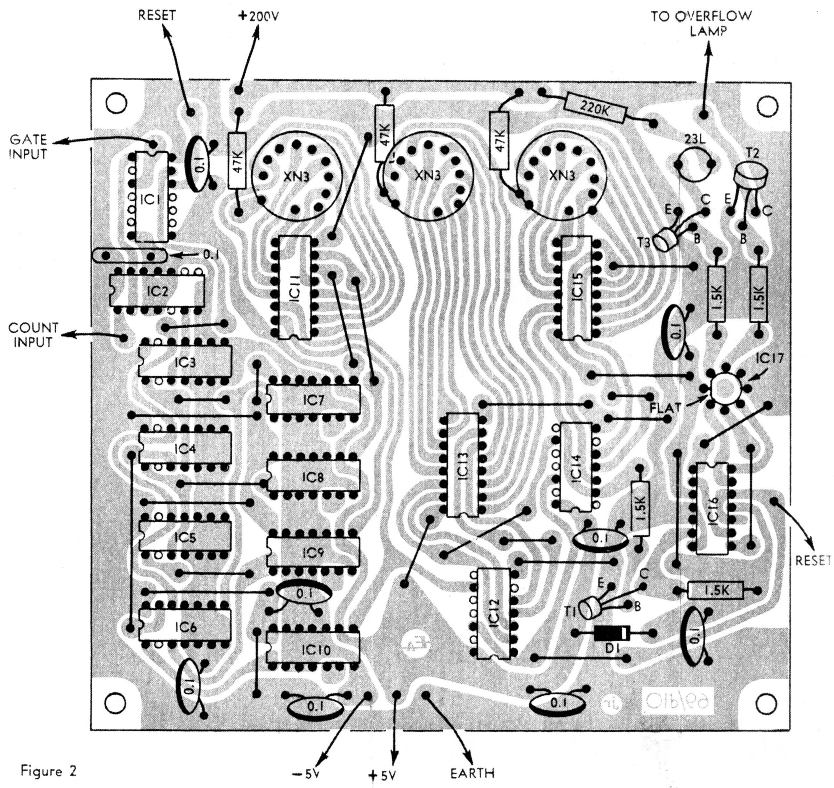


Figure 2

have any repetition rate up to approximately 40MHz.

The sampling or measurement "command" function of the instrument is performed by the reset pulses, which not only reset the counting register of the instrument, but also prime the input gating circuitry. Hence provision is made for a number of reset pulse sources, giving in fact four different sampling modes.

There are two automatic recycling modes, in which measurements are made at 5 per second and 1-every-8 seconds respectively. A third "manual" mode allows reset when required, using a second push-button on the front panel. The fourth mode is the "external" mode in which reset is initiated by a +3V/0V pulse applied to a rear panel connector.

The two internal sampling modes

employ reset pulses of 5Hz and 0.125Hz repetition rates, which are derived from the crystal timebase system. This obviates the cost of an independent free-running sampling generator, and involves only a slight restriction in terms of operating flexibility. The lower rate must be used for the 2KHz and 20KHz frequency ranges because of the gating times used for these ranges; however, either sampling rate may be used for the 200KHz and higher frequency ranges.

As the measuring or gating time involved in the time - period mode is variable, it is not possible to specify firmly which sampling rate or rates must be used for the various ranges. However in general, the lower rate may be used for all ranges, while the higher rate may be used alternatively for the 2mS and 20mS ranges.

Normally the internal sampling signals are not used in the "events counting" mode, instrument reset being performed either manually or by means of an external command pulse.

The input sensitivity of the instrument is better than 30mV P-P between about 100Hz and 3MHz, falling to better than 600mV P-P at 70MHz. The sensitivity may be reduced if necessary, for the measurement of signals in the presence of noise. Input impedance is approximately 2K ohms.

Overload protection is incorporated into the input circuitry, and the instrument is thus able to accept signals up to approximately 100V peak-to-peak without damage.

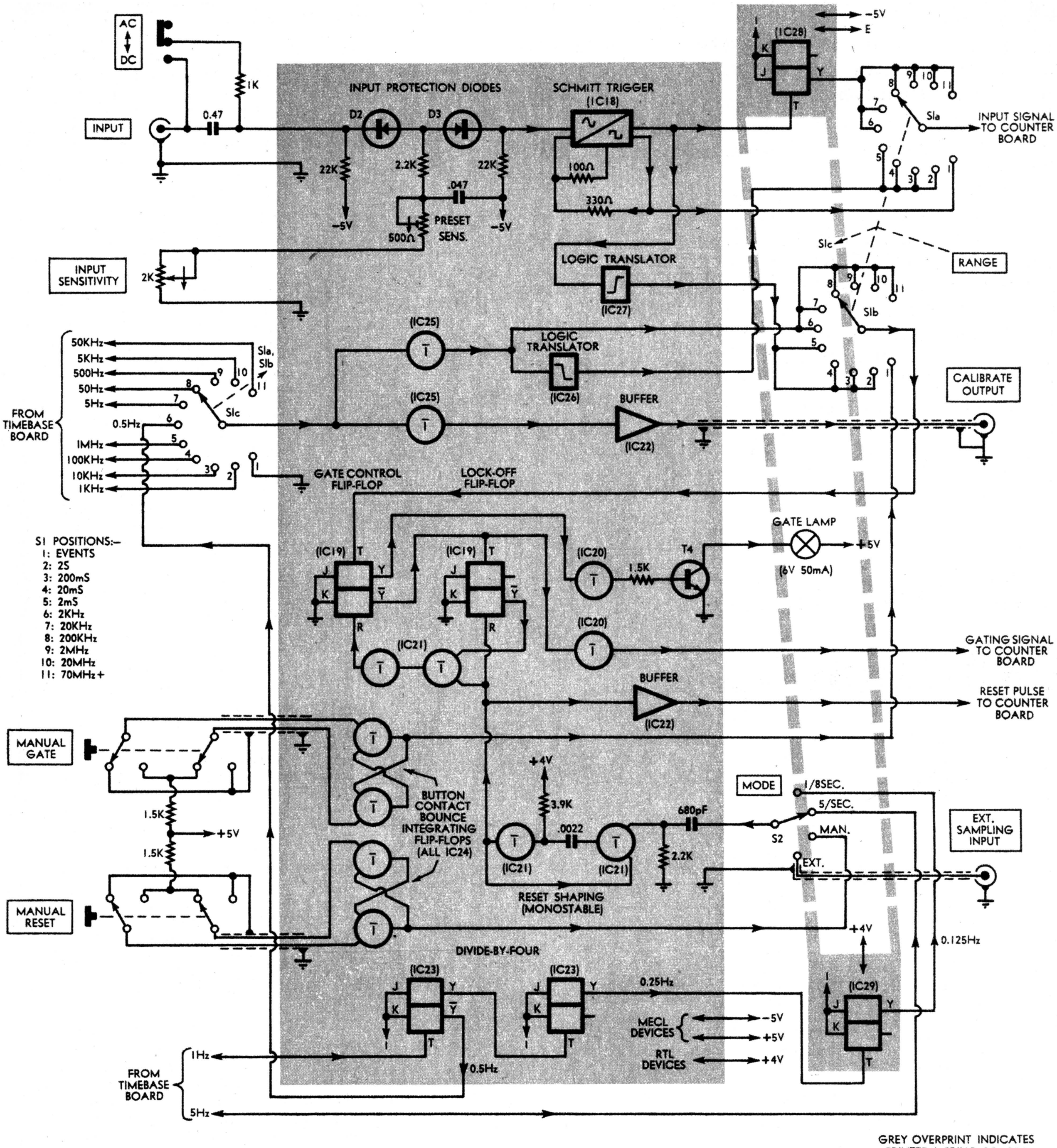
Apart from the power supply wiring, all of th circuitry of the instrument is mounted on printed wiring boards. This simplifies the construction considerably, so that, despite its relative complexity, the instrument should be capable of being constructed rapidly, easily and with confidence even by those with little experience of equipment construction.

There are four wiring boards, the largest of which supports the complete counting section including decoding and readout display. A smaller board, mounted beneath the counter board, provides the quartz crystal timebase frequencies. A slightly smaller board again mounts behind the input connector and main front panel controls and supports the input shaping, gating and logic and reset circuitry. Mounted above this board is the last, and smallest board of all, which supports the two additional microcircuits associated with the extension of the instrument response to 70MHz.

The logic/circuit diagram of the counter board is shown in figure 1. As may be seen, it includes some 17 microcircuits, three discrete transistors, three numerical indicator tubes, a neon lamp and a handful of minor components.

Input signal gating for the counter is performed on the counter board itself, by microcircuit IC2. As the counter gate must be capable of operation at the highest input frequency handled by the counter board, a high speed ECL-type device is used. The device is actually a Motorola MECL II unit, type MC1004.

As the devices used on the input board to generate the gating signal are saturated-logic RTL devices, the actual gating signal fed to the counter board has the corresponding logic convention. Because of this a "logic level trans-



GREY OVERPRINT INDICATES PRINTED WIRING BOARDS (69/c11, 70/c4)

Figure 3 — 70MHz DIGITAL FREQUENCY METER — INPUT BOARD AND WIRING

lator" is used to convert this signal into one compatible with the ECL gate device. The translation function is performed by one half of IC1, a Motorola type MC1017.

The first decade of the counter itself must also be capable of operating at the maximum input frequency handled by the counter board, and for this reason high-speed ECL devices are again used in this section. The decade consists of four Motorola type MC1013 flip-flops, which have a rated maximum toggle frequency of 70MHz minimum. These devices are shown on figure 1 as ICs 3, 4, 5 and 6.

The second and third decades of the instrument handle somewhat lower maximum frequencies than the input decade, and for this reason these decades use devices of lower frequency capability. The devices which are used in this case are type CuL 9958, from the Fairchild "Counting Micrologic" range. Each device is a complete decade counter (IC12, IC14), containing four flip-flops and associated feedback gating, and operating in 8421 BCD code.

The maximum toggle frequency of the CuL9958 devices is typically 4MHz. Because of this, it is actually device IC13 whose response limits the maximum input frequency at which the counter board will function reliably, rather than the devices in the input decade. Whereas the latter devices will function to approximately 80MHz, IC13 in fact limits the maximum frequency to 10 times its own toggling cutoff, or approximately 40MHz. The means whereby this basic counter limit is effectively extended to the "70MHz plus" response specified for the instrument as a whole will be explained shortly.

The outputs of each of the three counting decades is decoded into decimal notation and prepared for application to the numerical readout tubes by devices IC11, IC13 and IC15. These are combined decoder/lamp driver devices type CuL9960, again from the Fairchild Counting Micrologic range.

As the decoder/lamp driver devices employ DTL circuitry, logic level translators must be used between IC11 and the ECL flip-flops of the first counting decade. The devices used in these positions (ICs 7, 8, 9, 10) are Motorola type MC1018, which are expressly designed for ECL/saturated logic translation. Device IC10 also acts as a level

FERGUSON QUALITY TRANSFORMERS

OUTPUT TRANSFORMERS

Type No.	Nom. Watts	Primary Impedance (ohms)	Secondary Imp. (ohms)
Medium fidelity 40-30,000 cps minus/plus 2db.			
OPM 1A	5	7000, 5000	S.E. 15, 8 3.7, 2
OPM19A	5	7000, 5000	S.E. 500, 250, 166, 100
OPM 2A	7	10000	P.P. 15, 8 3.7, 2
OPM 7A	15	(10000) 8000, 7000	P.P. 15, 8 3.7, 2
OPM 8A	15	(10000) 8000, 7000	P.P. 500, 250, 166 100
OPM10A	25	(8000) 6600	P.P. 15, 8 3.7, 2
OPM 9A	25	(8000) 6600	P.P. 500, 250, 166 100
OPM14A	35	(8000) 6600	P.P. 15, 8 3.7, 2
OPM13A	55	3500	P.P. 15, 8 3.7, 2

Impedance in brackets indicate screen taps available.

OUTPUT TRANSFORMERS

Type No.	Nom. Watts	Primary Ohms	Secondary ohms
Hi-Fi Using Oriented Grain Steel for Mullard 5-Stereo-7 Playmaster 2 & 4			
OP412	7	9000 + Screen Taps	PP. 15 7.5 3.7 2
Hi-Fi for Mullard 5-10 Amplifier			
OP308/15	12	8000, 6000	P.P. 15 3.75*
Ultra-Linear			
OP301/15	12	8000 + Screen Taps	P.P. 15 3.75*
OP312/15	25	6600 + Screen Taps	P.P. 15 3.75*
For 6GW8's (ECL86's)			
OP447/15	12	8000 + Screen Taps	P.P. 15 3.75*
Ultra-Linear Oriented Grain Steel For 6BQ5's (EL84's)			
OP387/15	12	8000 + Screen Taps	P.P. 15 3.75*

*Also available in 8.4 and 2.1 ohms.

POWER TRANSFORMER
General Purpose—Valve Rectifier

Type No.	Primary Volts	H.T. Volts	H.T. mA	Low-Tension Secondaries
PF619	240	150/150	30	6.3V—1.8A
PF299	240	285/285	40	6.3V—2A 6.3V—tap5V—2A
PF201 PF151	240 230, 240	225/225 285/285	50 60	6.3V—2A 6.3V—2A C.T 6.3V—tap 5V—2A
PF1460	230, 240, 250	250/250	80	6.3V—2A C.T 6.3V—2A 6.3V—tap5V—2A
PF130	230, 240	285/285	100	6.3V—2A C.T 6.3V—2A 6.3V—tap5V—2A
PF174	230, 240	285/285	150	6.3V—3A 6.3V—3A C.T. 6.3V—tap5V—3A

POWER TRANSFORMER
General Purpose—Voltage Doubling

Type No.	Primary Volts	H. T. Volts (R.M.S.)	DC Output After Volts	Doubler mA	Low Tension Secondaries
PVD100	250 240 230	120 110 100	310 285 260	80	6.3V—3A CT
PVD102*	250 240 230	120 110 100	310 285 260	100	6.3V—4A CT
PVD103	250 240 230	50 140 130	380 355 330	100	6.3V—5A CT
PVD104	250 240 230	120 110 100	310 285 260	125	6.3V—3A CT 6.3V—3A
PVD105	250 240 230	146 136 126	380 355 330	125	6.3V—3A CT 6.3V—3A
PVD108	250 240 230	173 163 153	450 425 400	150	6.3V—3A CT 6.3V—3A
PVD109	250 240 230	146 136 126	380 355 330	180	6.3V—3A CT 6.3V—4A
PVD110	250 240 230	193 183 173	500 475 450	200	6.3V—3A CT 6.3V—4A
PVD111*	250 240 230	124 114 104	310 285 260	150	6.3V—3A CT 6.3V—3A CT

*Also available in flat mounting;

LOW VOLTAGE EQUIPMENT TRANSFORMER

Type No.	Primary Volts	Secondary Rating
PF537	240	17V tapped 11.5V—0.4A
PF1848	240	17V—1.25A
PF265	240	17V tapped at 11.5V, 10V, 8.5V at 4.2A
PF2344	240	18V, 0, 18V, 2.5A
PF2114	24	20V, 0, 20V, —2A DC
PF2440	240	19.4V, 0, 19.4V, —1.5A DC
PF2228 PF1763	240 240	30V—0.6A 30V tapped at 25V, 20V—2A
PF2876	240	32V at 1A 32V at 1A
PF2004	240	35V, 0 35V,—750mA
PF114	240	50V—2.3A tapped at 24V—4.8A tapped 12V—9.6A
PF115	240	50V tapped at 30V, 25V, 15V—5A
PF2235	240	150V, 125V, 100V, 75V, 50V, 25V, or 75V 0 75V at 30mA 6.3—1.2A

STEP DOWN TRANSFORMERS

Full range 240V to 12V-24V-32V-115V. 12VA to 2KVA enclosed with carrying handle fuse protection of output.

TRANSFORMERS FOR SPECIAL APPLICATION

Special transformers designed and manufactured to your specification 2VA to 5KVA. Available in open type — enclosed — encapsulated construction.

AVAILABLE ALL STATES FROM RECOGNISED ELECTRICAL WHOLESALERS

FERGUSON TRANSFORMERS PTY. LTD.

331 HIGH STREET, CHATSWOOD, N.S.W. ● POST OFFICE BOX 301, CHATSWOOD, 2067. TELEPHONE 40-0261 (8 LINES).
181-183 HAWKE STREET, WEST MELBOURNE, VICTORIA, 3003. TELEPHONE 329-7437

INTERSTATE AGENTS:

TASMANIA: Associated Agencies Pty. Ltd., 25 Barrack Street, Hobart, 7000. Phone: 2-1843.

A.C.T.: Erroll Nazer Pty. Ltd., 84 Barrier Street, Fyshwick, 2600. Phone: 9-0325.

QUEENSLAND: Keith Percy and Co. Pty. Ltd., Waterloo Street, Newstead, 4006. Phone: 51-5461.

WESTERN AUSTRALIA: Athol M. Hill, 613 Wellington Street, Perth, 6000. Phone 21-7861.

SOUTH AUSTRALIA: Wm. M. Matthew Pty. Ltd., 12 French Street, Adelaide, 5000. Phone: 23-6202.

translator for the carry-over to the DTL device IC12.

The numerical readout tubes used in the prototype instrument are low-cost side-viewing types from the English "Hivac" range. Designated type XN3, they provide easily read numerals some 14mM high, and are intended for printed wiring board mounting. The tubes are available via trade suppliers from the Imported Components Division of Plessey Ducon Pty. Ltd.

The printed wiring of the counter board has been designed to suit the XN3 tubes, and to our knowledge no other side-viewing numerical indicator tube of similar physical size and electrical ratings has exactly the same lead configuration. Because of this, no other tube may be used as an exact drop-in replacement. However Mullard Australia have recently released a tube whose lead configuration is only slightly different from the XN3, while being very similar electrically. This tube is the ZM1172, which could therefore be employed if some of the leads were insulated and carefully bent to correspond to the XN3 configuration. It may be noted that the ZM1172 actually offers a slightly larger numerical display than that offered by the XN3.

Counter over-range is performed by one half of IC16, which is a Motorola type MC790P dual J-K flip-flop. Carry-over from IC14 to the over-range flip-flop is taken via an inverter transistor T1, which is necessary because although the DTL device IC14 and the RTL device IC16 both use similar logic levels, they employ opposite logic conventions.

Readout for the over-range is performed by a neon lamp, driven by transistor T3. The neon lamp used is a special type having long electrodes, thus matching the numerals of the full decades. It is a Hivac type 23L, and is also available from Plessey Ducon Pty. Ltd.

Overflow detection is performed by the second flip-flop of IC16. The output of the flip-flop is fed via an inverter element to transistor T2, which drives the 6V/50mA panel indicator lamp. The inverter element is formed by half of IC17, which is a Fairchild type FuL914 dual gate.

The second half of IC17 is used as a NAND or inhibitor gate which prevents the over-range neon from operating when the counter has overflowed. This has been done to avoid ambiguity and prevent reading errors.

As may be seen, reset signals are applied to all three counting decades and also to both the over-range and overflow flip-flops. As the reset signals fed to the counter board have saturated logic levels, a level translator is used to feed the ECL input decade devices. The translator uses the second half of IC1.

Figure 2 shows the component placement and additional wiring on the counter board. Assembly of this board should be a simple and straightforward operation if this diagram is used in conjunction with figure 1.

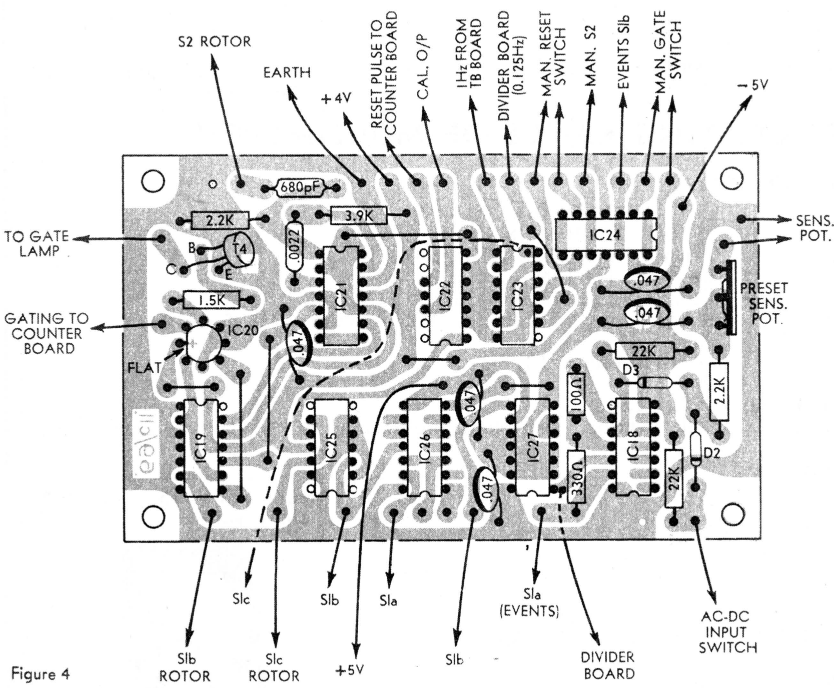


Figure 4

The logic/circuit diagram for the input and divider boards is shown in figure 3. In this version of the design 10 microcircuits are mounted on the input board, together with one discrete transistor, two diodes and associated minor components. The small divider board mounts two further microcircuits.

Squaring of the input signal applied to the instrument is performed by IC18, a high speed ECL gate connected as a Schmitt trigger. The device used for IC18 is a Motorola MC1035, which is capable of operation in this configuration to well beyond 70MHz.

Adjustment of input sensitivity is performed by varying the DC bias applied to the input of IC18. This is done by means of the 2K input sensitivity pot, mounted on the front panel, with a small preset 500-ohm unit on the board used to set the maximum sensitivity position of the main control.

Input overload protection is performed by the two diodes connected in series with the signal path to IC18. Normally biased in forward conduction along with IC18, the diodes are arranged to disconnect the input for peak signal excursions greater than a few hundred milivolts in either direction. In effect, all signals greater than about 500mV P-P are clipped to this amplitude before passing to IC18.

Naturally if large enough signals are applied, the PIV rating of one or both of the diodes will be exceeded, and damage may occur. As the AO91 diodes used have a PIV rating of 115V, the risk of this occurring should be very slight in most applications; however, the operator would do well to bear the possibility in mind.

Also on the input board is the counter gate control logic. This consists of two J-K flip-flop elements, an OR gate, three inverters and a discrete transistor. The two flip flops are provided by device IC19, which is a Motorola type MC790P. One half of the device is used as the gate control flip-flop, whose toggle (T) input is fed with the selected timebase signal from the range switch S1b.

It is the Y-bar output of the gate control flip-flop which is actually used to control the counter gate, being taken to the gating input of the counter board via a buffer/inverter using half of IC20, a Fairchild FuL914 device. The Y output of the flip-flop is fed via the second half of IC20 to transistor T4, which is used to operate the gate indicator lamp on the front panel.

As the gate control flip-flop must only be allowed to open the counter gate for a single timebase signal period for each measurement, its operation is controlled by a lock-off signal applied to its DC reset terminal. The lock-off signal is provided by the second flip-flop of IC19, which switches to the set state immediately the gate control flip-flop returns to the reset state after opening and closing the gate. The lock-off signal is applied to the reset input of the gate control flip-flop via an OR gate and inverter formed by two elements from IC21.

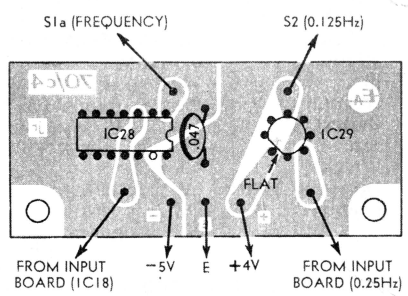


Figure 5

The purpose of the OR gate is to allow the gate control flip-flop to be reset, along with the lock-off flip-flop, by the normal instrument reset pulses. This is the means whereby the latter pulses act as the "sampling command" pulses in the instrument.

Shaping of the reset/sampling pulses is performed by the remaining two gates of IC21, which are connected in a monostable or "one-shot" configuration. The output from the monostable is fed directly to the gate control logic, and through a buffer amplifier (IC22) to the counter board. Device IC22 is a Motorola type MC788P dual non-inverting buffer.

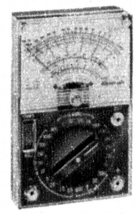
Selection of the reset/sampling signal source is performed by the mode switch S2. This selects one of four

University

Diode Protected General Purpose Multimeters

"University" have yet another model to add to their range of Multimeters. It is the model MVA-20, a modern designed unit with a high-impact all plastic case.

Model MVA-20 (20,000 ohms/volt)



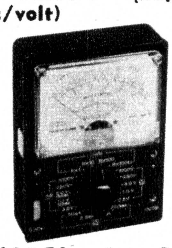
SPECIFICATIONS:

D.C.V.:	0.5-1-2.5-10-50-250-500-1000 (20KΩ/V)
A.C.V.:	10-50-250-500-1000 (10KΩ/V)
D.C.A.:	50uA-5-50-500mA
Ohms:	10K-100K-1M-10M
db:	−20/0/+22
Accuracy:	Plus or minus 3% for D.C. Plus or minus 4% for A.C.
Battery:	2 x 1.5V
Size:	5in x 3in x 1¼in
Weight:	10oz
Optional Extra:	Leather Case
Features:	Diode overload protection, Multicolour Scale, 90-day guarantee

Price $14.00 plus 15% Sales Tax

"UNIVERSITY'S" EXISTING RANGE OF MULTIMETERS

Model MVA-4 (20,000 ohms/volt)



Price $14.50 plus 15% Sales Tax

SPECIFICATIONS:

D.C.V.:	2.5-10-50-250-1000 (20 KΩ/V)
A.C.V.:	2.5-10-50-250-1000 (8 KΩ/V)
D.C.A.:	50 uA-2.5 mA-25 mA-250 mA
Ohms:	10K-100K-1M-10M
db:	−20/0/+22, +22/ +36
Accuracy:	Plus or minus 3% for D.C. Plus or minus 4% for A.C.
Battery:	3 x 1.5 V
Size:	6in x 4 3/16in x 2 1/8in
Weight:	1.34lb
Optional Extra:	Leather case
Features:	Diode overload protection, multicolour scale, engraved front panel 90-day. guarantee.

Model MVA-5 (20,000 ohms/volt)

SPECIFICATIONS:

D.C.V.:	5-25-50-250-500-2.5K (20K Ω/V)
A.C.V.:	10-50-100-500-1000 (10KΩ/V)
D.C.A.:	50 uA-2.5mA-250mA
Ohms:	0.6K-6M
db:	−20/0/+22
Accuracy:	Plus or minus 3% for D.C. Plus or minus4% for A.C.
Battery:	1 x 1.5V
Size:	4¼in x 3¼in x 1 1/8in
Weight:	10oz
Optional Extra:	Leather case
Features:	Diode overload protection, multicolour scale, engraved front panel, 90-day guarantee.

Price $10.00 plus 15% Sales Tax

Model MVA-100 (100,000 ohms/volt)

Price $35.00 plus 15% Sales Tax

SPECIFICATIONS:

D.C.V.:	0.5-2.5-10-50-250-500-1000 (100KΩ/V)
A.C.V:	2.5-10-50-250-1000
D.C.A.:	10 uA-250 uA-2.5 mA-25 mA-250 mA-10A
A.C.A.:	0-10A
Ohms:	20K-200K-2M-200M
db:	−20/0/+62
Accuracy:	Plus or minus 3% for D.C. Plus or minus 4% for A.C.
Battery:	2 x 1.5V + 22.5V
Size:	7in x 5¼in x 3in
Weight:	3lb
Optional Extra:	Leather case
Features:	Mirror scale, diode overload protection multi-colour scale, spring loaded shock resistant movement, engraved front panel, 90-day guarantee.

All backed by "UNIVERSITY" sales, spare parts and service, and are complete with test leads, batteries and instructions.

All test equipment can be inspected at

University Graham Instruments Pty. Ltd.

106 Belmore Road, Riverwood, N.S.W., 2210.
Telephones: 53 8758, 53 0644 (5 lines).
Telegrams and Cables: Racquip, Sydney.

REPRESENTATIVES:

W.A.: Atkins (W.A.) Ltd.
894 Hay Street.
PERTH: W.A. 6000.
TAS.: W. P. Martin and Co.
202 Argyle Street.
HOBART: Tas. 7000.
And 150 Wellington St.
LAUNCESTON: Tas. 7250. 22-844
S.A.: Compar Distributors Pty. Ltd.
33 Market Street.
ADELAIDE: S.A. 5000. 51-6263

QLD.: Keith Percy & Co. Pty Ltd., Waterloo Street.
NEWSTEAD: Brisb., Qld. 4006.
N.Z.: Alluin Electrical Co. Ltd.,
21 Liverpool Street,
AUCKLAND, N.Z.
NEWCASTLE DISTRICT:
Hunter Engineering Sales Pty. Ltd., Cnr. Gordon Ave. and Parry Street, Hamilton.
NEWCASTLE, N.S.W. 2303.
Phone 61-4321

FREQUENCY METER PARTS LIST

COUNTER BOARD

SEMICONDUCTORS

IC1: Motorola MC1017.
IC2: Motorola MC1004.
IC3, 4, 5, 6; MC1013.
IC7, 8, 9, 10: MC1018.
IC11, 13, 15: Fairchild CuL9960.
IC12, 14: Fairchild CuL9958.
IC16: Motorola MC790P.
IC17: Fairchild FuL914.
T1: 2N3565, BC108, TT3565, or TT108.
T2: 2N3569, or TT3569.
T3: 2N3568, SE7001, or BSX21.
Diode D1: EM401, BY126/50, etc.

REMAINING COMPONENTS

1 Printed board, code 69/d10.
3 XN3 numerical indicator tubes.
1 23L long-electrode neon tube.
4 1.5K ½ watt resistors.
3 47K ½ watt resistors.
1 220K ½ watt resistor.
9 0.1uF 25V ceramic capacitors.

INPUT BOARD

SEMICONDUCTORS

IC18: Motorola MC1035.
IC19, IC23: Motorola MC790P.
IC20: Fairchild FuL914.
IC21, IC24: Motorola MC724P.
IC22: Motorola MC788P.
IC25: Motorola MC715P.
IC26: Motorola MC1017.
IC27: Motorola MC1018.
T4: 2N3569, or TT3569.
Diodes D2, D3: OA91 or similar.

REMAINING COMPONENTS

1 Printed board, code 69/c11.
1 100 ohm ½ watt resistor.
1 330 ohm ½ watt resistor.
1 1.5K ½ watt resistor.
2 2.2K ½ watt resistors.
1 3.9K ½ watt resistor.
2 22K ½ watt resistors.
1 500 ohm tab pot (board mounting).
1 680pF polystyrene capacitor.
1 .0022uF 30V mylar, polyester or polystyrene.
5 .047uF 25V ceramic capacitors.

DIVIDER BOARD

IC28: Motorola MC1013.
IC29: Fairchild FuL923.
Printed wiring board, 70/c4.
1 .047uF 25VW ceramic capacitor.

TIMEBASE BOARD

SEMICONDUCTORS

IC30: Motorola MC799P.
IC31—IC43: Motorola MC790P (13 off).

REMAINING COMPONENTS

1 Printed board, code 69/c9.
1 2.000MHz quartz crystal (see text).
1 2-8pF NPO ceramic trimmer (see text).
1 22pF NPO ceramic capacitor.
1 .001uF polystyrene capacitor 400V or lower if available.
3 .047uF 25VW ceramic capacitor.
1 Socket to suit crystal.

CASE & POWER SUPPLY

1 Case 10½in x 8¾in x 4in, with front escutcheon plate.
1 Power transformer, 240V to 12.6V CT at 4A, 150V at 20mA.
1 Rotary switch, 3 sections, 1 pole, 11 positions.
1 Rotary switch, 1 pole 4 positions.
1 Mains fuseholder with 1A fuse.
4 Co-axial panel connectors.
1 Single-pole slider switch.
3 Miniature 6V/50mA lamp bezels (see text).
2 Miniature pushbuttons (see text).
1 Miniature SPDT toggle switch.

SEMICONDUCTORS

1 A14M, 1N5061 or similar silicon diode.
1 EM400, BY126/50 or similar silicon diode.
1 PA40 silicon bridge rectifier (8A).
2 Nominal 6.2V zener diodes, BZY88/C6V2 or similar.
2 2N3055, BDY20 or similar NPN power transistors.
1 AY8115, 40408 or similar NPN power transistor.
1 TT3638 or similar PNP power transistor (metal TO—5).

RESISTORS

4 220 ohm ½ watt.
1 1K ½ watt.
2 1.5K ½ watt.
1 150K 1 watt.
1 2K linear carbon pot.

CAPACITORS

1 0.47uF 400V polyester.
1 8uF 250VW electro.
2 100uF 6VW electro.
2 100uF 10VW electro.
2 3000uF 10VW chassis mounting electro.

MISCELLANEOUS

2 large instrument knobs, 1 small knob; 10-lug section of miniature resstior panel; 4-lug tagstrip; 3-segment length of "B-B" connector panel; 4½in x 1½in piece of orange tinted acrylic sheet (1/8in) for display window filter; grommet for mains cord (3/8in); mains cord and plug; cord clamp; mounting screws, nuts, lock washers, power transistor mounting hardware, connecting wire, solder, etc.

signals: (a) a 0.125Hz signal derived from the 1Hz timebase signal by the two flip-flops of IC23 (MC790P), and by IC29 (FuL923) on the divider board, giving the slow sampling rate; (b) a 5Hz signal taken from the timebase board, giving the faster sampling rate; (c) the "manual" signal generated by means of a front-panel "reset" button, with spurious bounce components removed by an integrating flip-flop using two elements of IC24 (MC724P); or (d) any suitable signal provided by an external reset/sampling source.

The signal selected by S2 is differentiated before being fed to the monostable, to ensure correct operation regardless of the duration of the selected signal. Any signal having a pulse width greater than about 100nS is thus quite suitable for use as an external reset source.

The second front-panel pushbutton and the remaining elements of IC24 are used to generate manual gating signals for the "events" counting function.

Devices IC25, IC26 and IC27 on the input board in this instrument were not used in the low-frequency version of the design. Devices IC26 and IC27 are logic level translators, being Motorola devices type MC1017 and MC1018 respectively. They perform the level translation necessary in the time period measurement mode, when the timebase signal is fed to the counter input while the input signal is used to control the counter input gate.

Device IC25 is a Motorola type MC715P dual 3-input gate, used here as a dual buffer element for the timebase signal selected by S1c. One half of the device feeds the time base signal to IC26, which converts it into an ECL level signal for use as the counter clock in the time period mode. This half of IC25 also provides the RTL level timebase signal fed to the gate control flipflop via S1b, in the frequency mode.

The timebase signal from the second half of IC25 is fed to the second buffer element of IC22, as may be seen. The latter element thus provides the "calibrate output" signals at the appropriate rear-panel connector.

Depending upon the setting of switch S1, the signal available at the rear-panel connector is thus one of the following frequencies, all of which are derived from the 2MHz crystal oscillator: 1MHz, 100KHz, 50KHz, 10KHz, 5KHz, 1KHz, 500Hz, 50Hz, 5Hz or 0.5Hz. As noted earlier, these signals may be used for calibration of receiver dials; they may also be useful as test signals for digital circuits, and as marker signals for sweep alignment.

As noted in the foregoing, one of the two mircrocircuits on the small divider board (IC29) is used to derive the 0.125Hz reset signal used for the lower sampling rate of the instrument. The second device, IC28, is a Motorola type MC1013 which is the device actually used to extend the frequency range of the instrument to above 70MHz.

The operation of IC28 is quite simple. Connected in straightforward toggle mode, it simply divides the squared signal from IC18 by two, fcr each of the six frequency measurement ranges. Hence the counter board with its basic 40MHz capability is only called upon to handle signals whose frequency is half that of the input signals.

Of course, if this 2:1 signal frequency division were provided alone, without change to the timebase signals used for the various frequency ranges, the instrument would give readings corresponding to half the actual input frequency. Hence in order to make the instrument read the correct frequency, we have arranged for the timebase signal of each range to be at half the frequency normally used. This effectively doubles the measurement gating time, and hence compensates for the 2:1 division in input frequency.

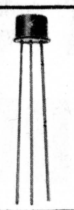
By this simple means, the response of the new instrument has been extended from the 40MHz capability of the counter board itself, to better than 70MHz. The actual cutoff frequency of the instrument is now determined primarily by the highest frequency at which the Schmitt trigger element IC18 will operate reliably.

The placement of components and interconnection wiring for the input and divider boards is shown in figures 4 and 5. Using these in conjunction with the circuit/logic diagram of figure 3, it should again be a simple matter to assemble and interconnect these boards.

(To be continued)

SILICON CONTROLLED RECTIFIERS.

Item	Symbol	2SF 101	2SF 102	2SF 104	2SF 106	2SF 108	2SF 656	2SF 657	2S 658	Unit
*Non Rep. P.R.V.	$V_{R\ surge}$	75	150	300	400	500	75	150	300	V
*Rep. P.R.V.	V_{RM}	50	100	200	300	400	50	100	200	V
*Rep. PK. Fwd. Blocking Voltage	V_{FOM}	50	100	200	300	400	50	100	200	V
Avg. Rect. Current	I_O	200(T_a=50°C) / 470 r.m.s.					300(T_a=25°C)			mA



SILICON CONTROL RECTIFIERS.

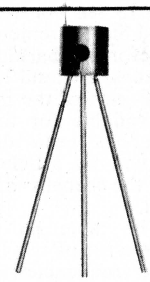
Item	Symbol	2SF 660	2SF 661	2SF 662	2SF 664	Unit
Non Rep. P.F.V.	$V_{F\ surge}$	75	150	300	600	V
Non Rep. P.R.V.	$V_{R\ surge}$	75	150	300	600	V
Rep. Pk-Fwd. Blocking Voltage	V_{FOM}	50	100	200	400	V
Repetitive P.R.V.	V_{RM}	50	100	200	400	V
Avg. Rectified Current	I_O	3.5(Ta=50°C)FN11 H.Sink / 6.3(Tc=50°C) 10Ar.m.s.				A
PK 1 cycle surge	I_{surge}	50				A

BIDIRECTIONAL THYRISTER.

ITEM	Symbol	AC06BR	AC06DR	AC10BR	AC10DR	UNIT	REMARKS
Peak Block Voltage	V_{BLM}	200	400	200	400	V	
Conduction RMS Current	I_{RMS}	6		10		A	Tc=75°C or Ta=40°C With FN12 H.Sink
Surge Current	I_{surge}	50		80		A	1 Phase, 1 Cycle
Peak Gate Current	V_{GM}	±10				V	
Peak Gate Current	I_{GM}	±3.0				A	
Peak Gate Power	P_{GM}	5.0				W	
Avg. Gate Power	P_{GAV}	0.5				W	
Junct. Temp.	T_j	100				°C	
Storage Temp.	T_{stg}	—25~+100				°C	
Stud Torque	—	30		35		kg cm	

PLANAR TYPE UNIJUNCTION TRANSISTOR.

ITEM	Symbol	2SH16 2SH17 Condition	
Power Dissipation	P	200	mW
Emitter Rev. Voltage	V_{B2E}	30	V
Interbase Voltage	V_{BB}	25	V
Peak Emitter Current	I_{EM}	1	A
Emitter Current	I_E	50	mA
Junction Temp.	T_j	—20~+125	°C
Storage Temp.	T_{stg}	—20~+125	°C



TRIGGERING DIAC.

ITEM	Symbol V413	Specification MIN.	Typ.	MAX.	UNIT
Breakover Voltage	$V_{BO1}(V_{BO2})$	26	—	40	V
B/Over Voltage Symmetry	$\Delta V_{BO}(\lvert V_{BO1} - V_{BO2}\rvert)$	—	—	3.5	V
B/Over Current Symmetry	$I_{BO1}(I_{BO2})$	—	—	200	μA
B/Over Voltage T/C		—	0.1	—	%/°C
Peak Output Voltage	V_P	4.5	—	—	V

For more details and free brochures fill in the coupon:
Please send me information on

....

....

NAME...

COMPANY...

ADDRESS...

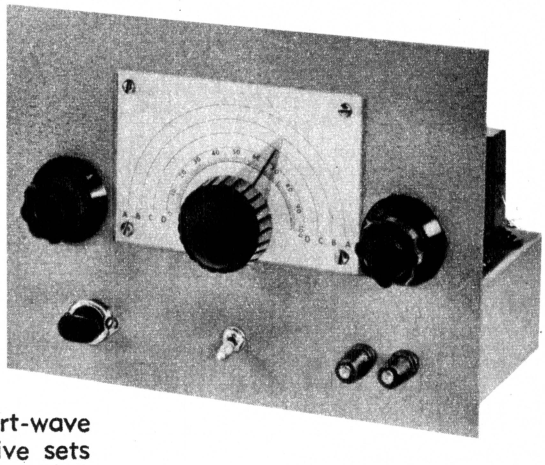
....POSTCODE.......................

Standard Telephones & Cables Pty. Limited
Moorebank Avenue, Liverpool, N.S.W. 2170

STC

AN ITT ASSOCIATE worldwide telecommunications and electronics

A SOLID STATE FREMODYNE



By Ian Pogson

Experimenters who have experienced the thrill of short-wave reception on simple two and three stage regenerative sets frequently inquire whether there is an equivalent set which will allow them to explore the VHF bands. The nearest approach is the superregenerative set, of which the Fremodyne is our favourite version. And of the Fremodynes, we tip that this solid state design will prove most popular.

It is now nearly eight years since we described the original Fremodyne Four. As some readers had problems with the construction of this receiver, we presented a modified version in March, 1967.

From the very outset, this concept of a simple VHF receiver enjoyed popular and unending appeal. However, as time went on, we continued to receive requests for a solid state version of the Fremodyne. Due to pressure in other directions, we have only recently been able to see our way clear to develop a Solid State Fremodyne.

Before embarking on the description, perhaps it would be wise to look at the VHF part of the spectrum and see what is available for the interested listener. This has been discussed in previous Fremodyne articles but is summarised for the benefit of newcomers to this field.

The table on page 57 shows that quite a lot of use is now being made of these frequencies. First and foremost, a dozen or so television channels are located in this part of the spectrum. While the average experimenter will generally have access to local TV stations by way of a receiver in the loungeroom, their frequency modulated sound carriers are also available as a source of powerful signals for a simple sound receiver.

In addition, there are two amateur bands which provide, in the main, technically orientated discussions during most evenings and at the weekends.

Elsewhere are channels allocated to two-way radiotelephones operated by government services, public utilities and private companies, some using amplitude modulated signals and some frequency modulated. While the content of such telephone conversations is of no immediate concern to the casual listener and, in fact, must be treated as confidential, their presence can serve both as guide to the performance of the receiver and as an indication of the extent to which such communications are used in day-to-day activities.

One point that should be emphasised is that, for the most part, the signals to be heard in this part of the spectrum are of a local nature. VHF signals, particularly above 50MHz, are not often heard beyond about 20 or 30 miles from their source. This is a valuable characteristic for short-range systems as it means that the same set of frequencies can be used over and over again in suitably separated centres of population.

However, it also means that there will be little to be heard by an enthusiast living in areas remote from such activities.

Before discussing the circuit, it might be interesting to examine the reasons for its choice.

Initially, we decided to make a solid state VHF receiver based on the simple and well-tried superregenerative principle. A typical circuit is shown in figure 1. A tuner was made up which was a slight elaboration of figure 1. This arrangement worked very well, as far as reception of signals was concerned, and it covered the range from 30MHz to about 250MHz. The sensitivity was little short of amazing, considering the simplicity of the circuit.

Superregenerative receivers in the past, using valves, always presented the problem of radiation at the received frequency, which could cause serious interference to others receiving the same signal. This often led to more elaborate designs, such as the introduction of an isolating stage, to reduce the radiation nuisance to a minimum.

We were aware of this problem but we also reasoned that transistor equivalent circuits were operated at considerably lower power levels than those of the former valve circuits. Hopefully, after having tested the receiver for its reception qualities, one of our staff took it home to try it under typical listening conditions.

It was a rather sad-faced individual who appeared on Monday morning, with said receiver under his arm. He intimated that the little monster worked very well as far as reception was concerned but it blacked out his television receiver — and possibly others in the neighbourhood

And so our theory on reduced radiation was dashed to the ground. This naturally led to a complete re-thinking of the project and another look at the Fremodyne approach. Here, a superregenerative detector is used on a fixed frequency of 27MHz, where any radiation is not so important. Ahead of this detector is a mixer and local oscillator, which converts the incoming signal from the VHF region to 27MHz, where it is further amplified and detected. The audio from the detector is then fed to a conventional amplifier.

These requirements did not seem unreasonable in the light of current solid state techniques. The audio amplifier would be no problem and could be considered as routine. The superregenerative stage could presumably be that which we had used for the initial VHF receiver but changed to be fixed-tuned to 27MHz. It only needed the

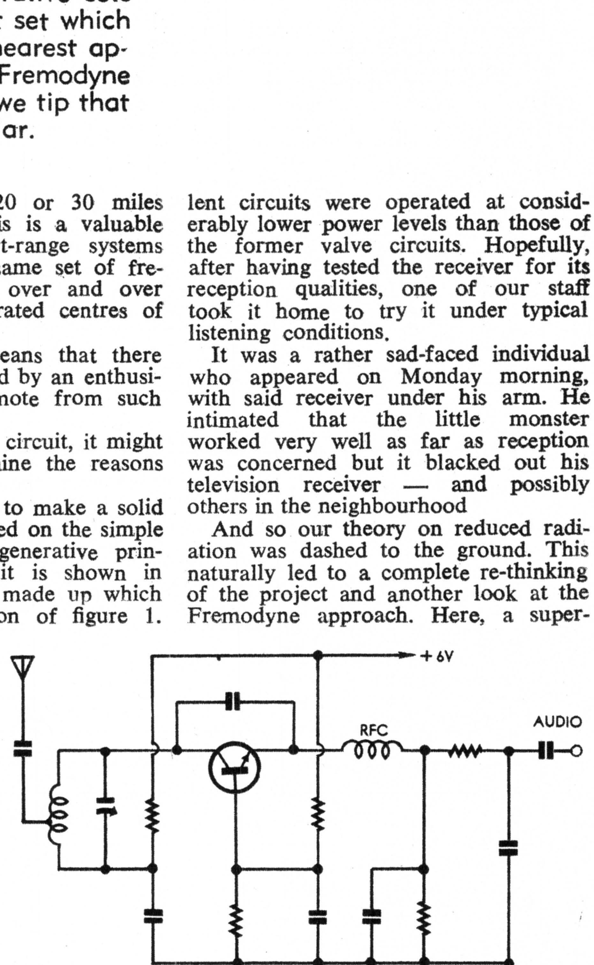
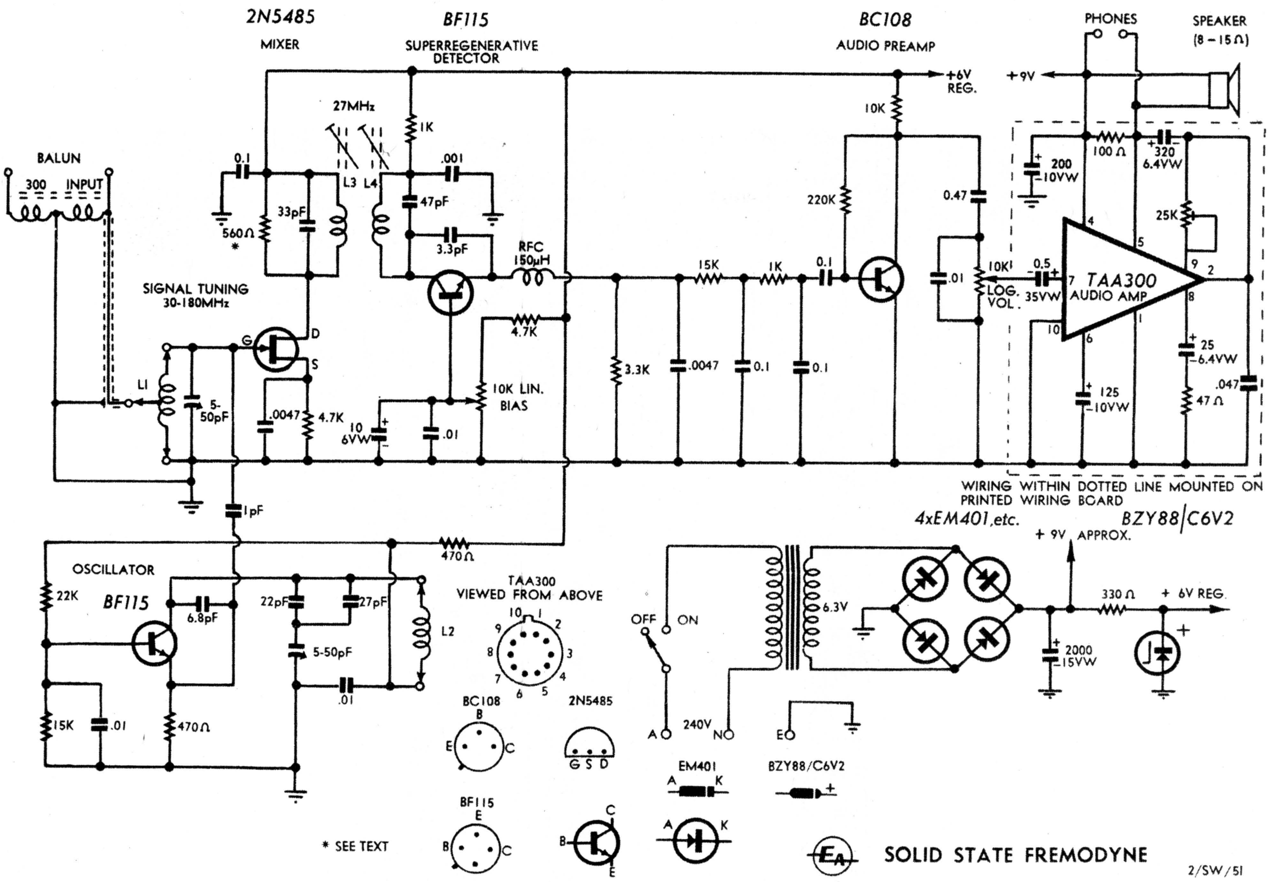


Figure 1. A basic superregenerative circuit. The experimental model we tried was only slightly more elaborate. It worked well, but created severe interference problems.

Figure 1

BASIC SUPERREGENERATIVE RECEIVER



The circuit uses a FET mixer in conjunction with a local oscillator to convert the incoming signal to approximately 27MHz. It is then fed to a superregenerative detector which causes little interference when operating at this frequency.

addition of a mixer and local oscillator to convert the wanted signal to 27MHz.

With an audio system already available, the next logical step was to tune the superregenerative stage to 27MHz. This was achieved by simply changing the coil and capacitor of the tuned circuit and making some circuit value changes to give optimum performance at this frequency.

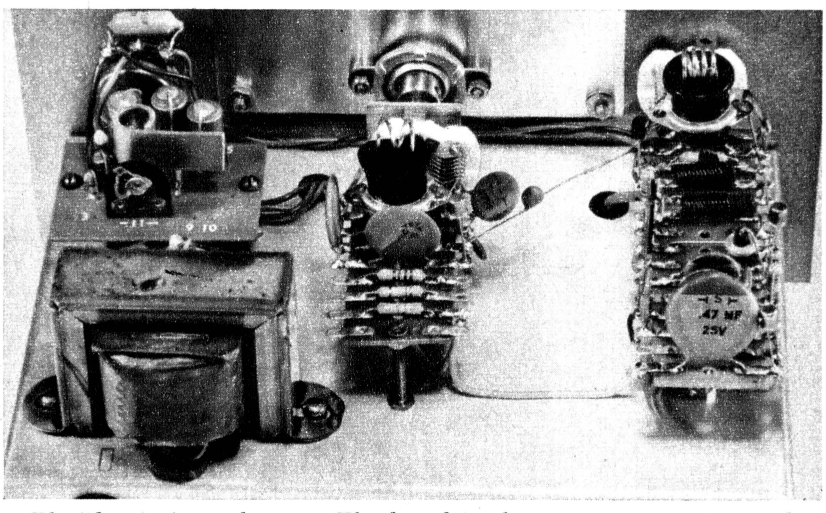
The selection of a local VHF oscillator for the first conversion process posed no real problems. Such requirements as stability, simplicity, and available output voltage for the mixer, were met by the oscillator circuit which we used for the Solid State Dip Oscillator.

The mixer was the subject which called for our closest attention. We tried a "ring" mixer first, which we have used with much success recently. Unfortunately it soon became evident that we needed very high speed switching diodes. Recovery time of the order of a very few nanoseconds was essential if we were to handle signals up to 200MHz or so. Here, we were faced with the problem of availability and cost of high speed diodes. We tried the fastest which we could obtain, consistent with reasonable cost, and they did function but not really to our satisfaction. It appeared that we must look elsewhere for a suitable mixer.

Still clinging to the idea of a balanced mixer, we replaced the four diodes of the original ring mixer, with a pair of junction FETs, still retaining the input and output transformers. This mixer worked very well, holding its efficiency to at least 200MHz and gave a small amount of gain, compared with the insertion loss of the diode mixer.

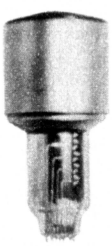
Still not satisfied that this was the complete answer, on the grounds that it was rather more elaborate than we considered suitable for a relatively simple receiver, we considered the possibility of a single junction FET in a conventional mixer circuit.

A junction FET, type 2N5485, was set up and this proved to be quite satisfactory, although the gain was not as good as the balanced FET mixer using the same type of FET. As we were looking for a satisfactory mixer, consistent with low cost and simplicity, we decided that the single FET was the best choice. The only other point to be settled for the mixer was the best method of injection from the local oscillator. The most convenient method turned out to be gate injection, which



The chassis from the rear. The board in the centre carries the local oscillator, while the one at the right carries the mixer, superregenerative detector and audio preamplifier.

RCA

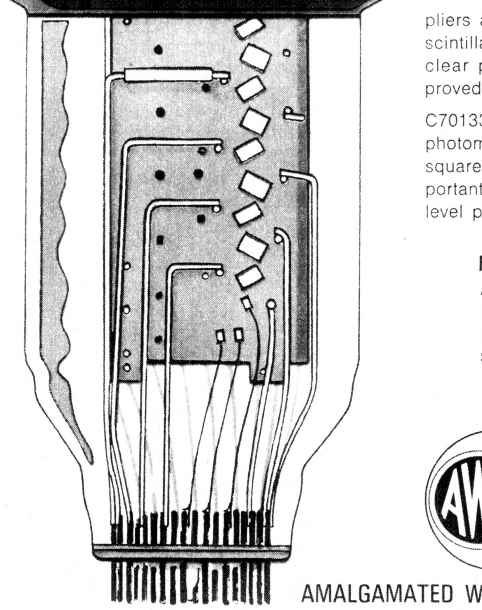


Here's an exciting new light sensitive device from RCA—the C70133B, an RCA QUANTACON photomultiplier—that can open up for study events never "seen" before.

Gallium Phosphide boosts the single electron resolution of this newest QUANTACON photomultiplier as much as 10 times over that of tubes using conventional dynode materials. As a result, it is possible for this device to discriminate between light-producing phenomena that generate one, two, three, or four photoelectrons.

Gallium Phosphide QUANTACON photomultipliers are at the forefront for applications in scintillation counting, biochemistry, and nuclear physics. C70133B offers greatly improved low-light-level performance.

C70133B is a high-speed RCA QUANTACON photomultiplier with an irradiation area of 15.9 square inches. This 5-inch device is an important tool for scientists studying low-light-level phenomena.



For technical details write to Amalgamated Wireless Valve Co. Pty. Ltd., Private Mail Bag, P.O. Ermington 2115 or Interstate Offices and Distributors.

AWV

AMALGAMATED WIRELESS VALVE CO. PTY. LIMITED

is efficient and easy to put into operation.

The result of all this is the receiver portrayed in the photographs and circuit diagram. In spite of the fact that it makes no use of reflexing, as did the valve versions, it has a sensitivity which, on a side by side test, appears to be at least as good as the earlier ones. Also, we believe, the absence of reflexing will make the set a good deal less critical and much easier for the home constructor to duplicate.

The circuit is worth studying in some detail. At the aerial input terminals is a "balun" or balanced-to-unbalanced transformer. This is an optional item, about which more will be said later. Next is the aerial tuned circuit, consisting of a coil (L1) and variable tuning capacitor. To cover the tuning range three coils are necessary, and we have used the well tried plug-in principle.

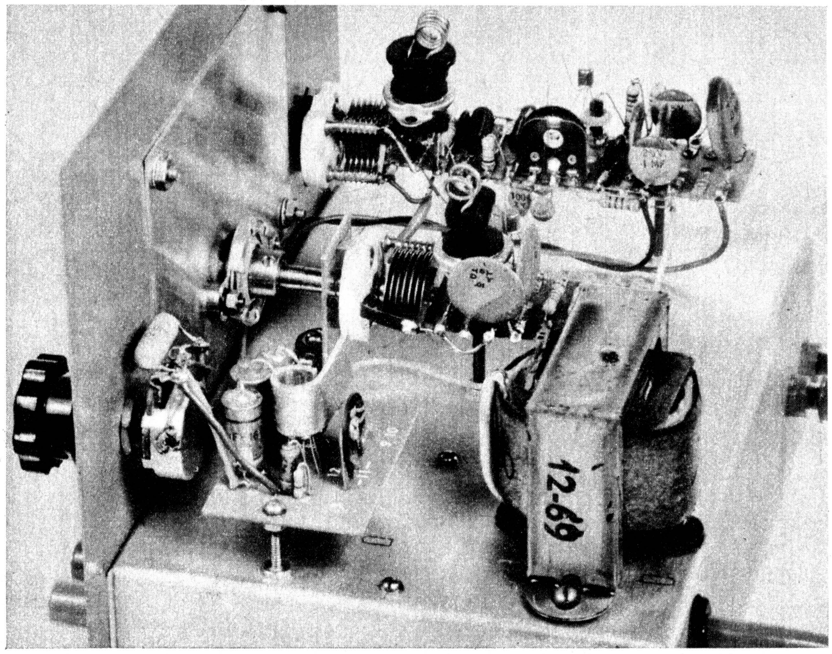
The mixer is a junction FET, type 2N5485, which is rated into the VHF range. In common with this type of mixer it is biased well back, with a 4.7K resistor in its source. The drain load is a tuned circuit on 27MHz, suitably damped.

This damping resistor was needed to maintain stability, using the particular combination of components in our prototype. Its value may need to be varied with individual sets and should be determined experimentally. The simple rule is to make it as large as possible (or omit it altogether) consistent with stable operation.

The main tuning of the receiver is by means of the local variable oscillator, L2 and its associated tuning capacitor. At the lower signal frequencies the oscillator operates on the high side of the incoming signal. At the high frequencies it operates on the low side. Also, by using the plug-in coil designed for the highest frequency range, but setting it on the high side of the incoming signal, we are able to cover the middle frequency range. This means that although we have three ranges, requiring three plug-in coils for the signal frequencies (L1), we need only two plug-in coils for the oscillator (L2).

To achieve a measure of band spread, the range of the oscillator tuning capacitor is restricted by connecting capacitance in series with it. Two fixed capacitors, 22pF and 27pF are connected in parallel, giving a total of 49pF which is about right for our purpose. By using two capacitors in parallel, we are able to reduce slightly the inductance of the circuit due to connecting leads. The output of the oscillator is injected into the gate of the mixer via a 1pF capacitor.

At this stage, some readers may be comparing the frequency coverage of this receiver with previously described valve Fremodynes. An upper frequency limit of around 250MHz was achieved with the valve versions, whereas we are only claiming about 180MHz for the transistor version. Actually, the upper limit of the prototype is about 189MHz. This may vary from one unit to another. The limiting factor appears to be the minimum capacitance in the circuit, contributed largely by the tuning capacitor associated with L2. Attempts to offset this by reducing the inductance of L2 resulted in an L/C combination which would not oscillate at the higher frequencies at which we were aiming.



This view of the chassis gives a clearer picture of the oscillator and aerial tuning capacitors associated with their respective boards. The power transformer and audio board are in the foreground.

The output of the mixer is magnetically coupled to the following stage, by means of L3 and L4 which are tuned to 27MHz. This is the superregenerative stage. More precisely it is a squegging oscillator, designed to squegg or "quench" at about 20KHz. Comparing this with the local oscillator feeding the mixer reveals a marked similarity. Both have their collectors tuned, both have a feedback capacitor from collector to emitter, both have their bases grounded to RF, and the output is taken from the emitter circuit in both cases.

However, there are also differences. While the bias to the base of the VHF oscillator is fixed, the bias to the superregenerative oscillator is adjustable. This is important in that it enables the user to set the bias on this oscillator so that it performs its complex functions properly.

There is also a difference in the time constant in the emitter circuit of the superregenerative detector. This consists of a 3.3K resistor, shunted by a

PARTS LIST

1 Chassis 8in x 5¼in x 2in.
1 Front panel 9in x 6-5/8in.
1 Power transformer 6.3V at 1 to 2 amps.
1 Slow-motion dial and knob, Jabel, etc.
2 Knobs.
4 Terminals.
2 2-pin miniature speaker sockets.
1 4-pin miniature speaker socket.
3 2-pin miniature speaker plugs.
3 4-pin miniature speaker plugs.
1 SPST toggle switch.
1 Audio printed board, RCS 745 or similar.
1 Miniature tag board, 8 prs. tags.
1 Miniature tag board, 10 prs. tags.
1 Miniature tag board, 15 prs. tags.
1 Balun former.
1 Miniature tag strip, 1 tag required.
5 Rubber grommets.
1 Cable clamp.
2 Slugs, 7-8mm, grade 900, Neosid or similar.
1 RF choke, 150uH.
2 Transistors, BF115 or similar.
1 FET, 2N5485.
1 IC, TAA300.
4 Power diodes, EM401 or similar.
1 Zener diode, BZY88/C6V2.
Sheet metal for bracket and heat sink, power flex and plug, hookup wire, solder, lugs, screws, nuts, tinned copper and enamelled wire, etc.

RESISTORS (all ½ watt)

1 47 ohms.	*2 1K.*
1 100 ohms.	*1 3.3K.*
1 330 ohms.	*2 4.7K.*
2 470 ohms.	*1 10K.*
2 15K.	*1 560 ohms.*
1 22K.	*1 220K.*

1 10K preset potentiometer.
1 10K log potentiometer.
1 25K preset potentiometer.

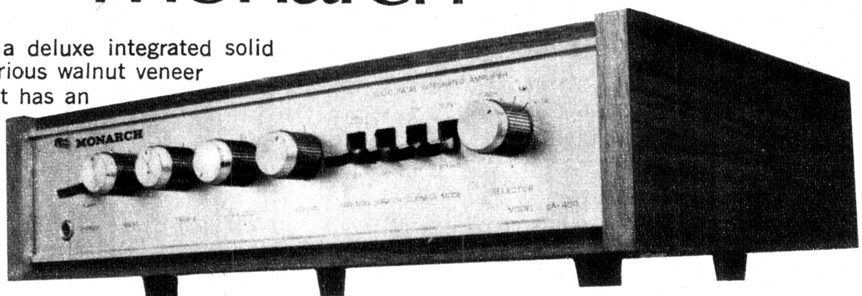
CAPACITORS

1 1pF NPO ceramic.
1 3.3pF NPO ceramic.
1 6.8pF NPO ceramic.
1 22pF NPO ceramic.
1 27pF NPO ceramic.
1 33pF NPO ceramic.
1 47pF NPO ceramic.
2 5-50pF miniature variable.
1 .001uF High-K ceramic.
2 .0047uF 25V ceramic.
1 .01uF 25V ceramic.
1 .01uF low voltage polyester (volume control).
2 .01uF high-K ceramic (oscillator).
1 .047uF 25V ceramic.
4 0.1uF 25V ceramic.
1 0.47uF 25V ceramic.
1 0.5uF 35VW electrolytic.
1 10uF 6VW electrolytic.
1 25uF 6.4VW electrolytic.
1 125uF 10VW electrolytic.
1 200uF 10VW electrolytic.
1 320uF 6.4VW electrolytic.
1 2000uF 15VW electrolytic.

The pocket priced sound maker

monarch

The Monarch SA-400 is a deluxe integrated solid state stereo amplifier with luxurious walnut veneer cover. Flexible and compact, it has an ample power output of 10 Watts continuous per channel to the speakers. Includes Phono (both magnetic and ceramic), Tuner and Auxiliary Input, Tape-In and Tape-Out for tape recording, playback or monitoring.



The Monarch SA500/W amplifier — a deluxe solid state unit. Versatile and compact, it provides an ample output of 34 watts continuous power, to the speakers. Includes Phono, Tuner and Auxiliary Input and Tape-Out for tape recording. Smoothly styled in a handsome walnut veneer cover. Careful selection of high-quality components in these amplifiers ensures trouble-free operation in the Monarch tradition of fine quality.

MONARCH 500/W $129 R.R.P.

FACILITIES

Front Panel: Selector—Aux; Tuner; Phono; Mono-Stereo Volume • Bass • Treble • Loudness • High Filter • Low Filter • Power • Phone Jack

Rear Panel: Input—Mag; Ceramic; Tuner; Tape; Tape Output • Speaker Terminals • AC Output • AC Fuse • Speaker Fuse

SPECIFICATIONS

Output Power: 42 Watts Total Music Power (IHF) into 8 ohms • 17½ Watts RMS each channel into 8 ohms.
Harmonic Distortion: Less than .9%
Frequency Response: 20-20,000 Hz + 1 DB
Channel Separation: Over 50 DB
Hum and Noise: Over 55 DB
Loudness: 50 Hz + 10 DB; 10,000 Hz + 4 DB
Tone Controls: Bass 50 Hz + 10 DB; —12 DB; Treble 10,000 Hz + 10 DB —12 DB
Low Filter: 50 Hz —10 DB
High Filter: 10,000 Hz —10 DB
Input Sensitivity: Mag. 3MV at IKHZ. Tuner 150MV at IKHZ. X'tal 150MV at IKHZ. Aux. 150MV at IKHZ.
Power Suppiy: 240 Volt A.C.
Dimensions: D — 10″, W — 14⅞″, H — 5″.

MONARCH S.A.400 $105 R.R.P.

FACILITIES

Front Panel: Selector—Aux; Tuner; X'tal; Phono • Volume • Balance • Treble • Bass • Loudness • Mode-Stereo • Mono • Tape Monitor • Power • Phone Jack • High Filter

Rear Panel: Input—Mag; X'tal; Tuner; Aux; Tape-Input; Tape-Output • Speaker Terminal • AC Output • AC Fuse • Speaker Fuses.

SPECIFICATIONS

Output Power: 28 Watts Total Music Power (IHF) into 8 ohms • 10 Watts RMS each channel into 8 ohms.
Harmonic Distortion: Less than 1%
Frequency Response: 30-20,000 Hz
Channel Separation: Over 50 DB
Hum and Noise: Over 60 DB
Loudness: 50 Hz + 10 DB; 10,000 Hz + 4 DB
Tone Control: Bass 50 Hz + 12 DB —12 DB; Treble 10,000 Hz + 12 DB —12 DB
Scratch Filter: 10,000 Hz — 10 DB
Input Sensitivity: Mag 3MV at IKHZ. Tuner 150MV at IKHZ. Aux 150MV at IKHZ. X'tal 150MV at IKHZ
Power Supply: 240 Volt A.C.
Dimensions: D — 9½″, H — 3¾″, W — 13½″.

Australian Distributors: **W.C. Wedderspoon**

SHOWROOM: 193 CLARENCE STREET, SYDNEY. 29-6681

AVAILABLE FROM ALL HI-FI SPECIALISTS IN ALL STATES

.0047uF capacitor. This time constant causes the superregeneration effect, which amounts to switching the oscillator on and off at a supersonic ("quench") rate dictated by the time constant.

To understand this better, envisage this circuit without the .0047uF capacitor. In these circumstances the circuit would not oscillate. If we now replace the .0047 capacitor it will, at the moment of connection, act as a short circuit across the 3.3K resistor. Thus the circuit commences to oscillate. At the same time the capacitor commences to charge, since there is a voltage developed across the 3.3K resistor due to the current flowing in the emitter circuit. As the capacitor charges, its ability to "short out" the 3.3K resistor becomes less until, eventually, the presence of this resistor causes the circuit to cease oscillating.

When this happens the emitter current through the 3.3K resistor drops to a very low value. There is now nothing to maintain the charge across the capacitor and it discharges into the 3.3K resistor, eventually reaching a point where it once again effectively "shorts out" the 3.3K resistor. The circuit then commences to oscillate again and the whole cycle is repeated. The rate at which this happens can be controlled by selecting the values of R (3.3K) and C (.0047uF). In this set the quench frequency is in the region of 20KHz.

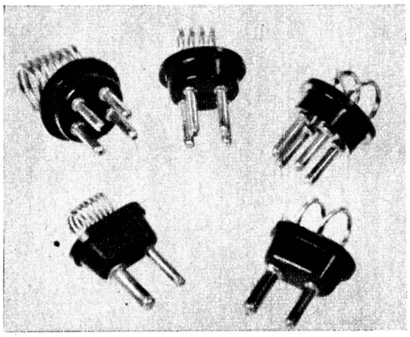
This type of circuit has a very high sensitivity and, although it has little application in the high frequency range, it is still useful in the VHF range, particularly where economy is paramount.

Immediately following the detector, is a two-section low pass filter. Its function is to remove any RF component, as well as the supersonic quench frequency of the detector.

The low level audio emerging from the filter is amplified by the audio preamplifier. This is a simple transistor amplifier with some negative feedback.

The output of the preamplifier is passed through a volume control and then to the main audio amplifier. This uses a Philips TAA300 IC mounted on a small printed board with its associated components. It is the same amplifier which we used on the 1970 All-Wave Two. The power output is about 1 watt into an 8 ohm speaker, which is the lowest value which can be used. A 15 ohm speaker may be used, with a reduction in power output.

The power supply is quite simple. It consists of a readily obtainable transformer, with a secondary of 6.3 volts rated at about 2 amps. This feeds a bridge rectifier for four silicon power diodes. The main filter is a 2000uF electrolytic capacitor and the voltage at this point is very near to 10 volts. This is the maximum voltage which may be used for the audio amplifier and it is fed directly from this point. As the

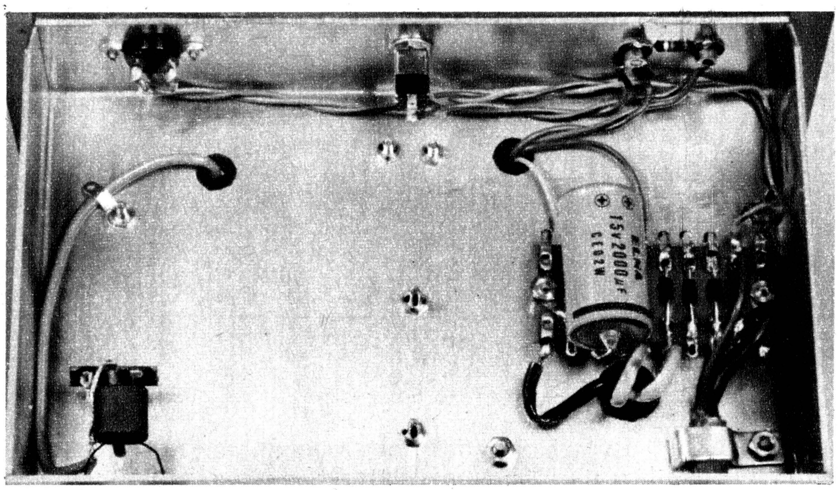


At the top are the three aerial coils and below them the two oscillator coils. One oscillator coil serves two bands.

audio amplifier is operated in class B the voltage will vary somewhat and we have regulated the supply to the rest of the receiver from a 6 volt zener diode.

The unit is constructed on an aluminium chassis measuring 8in x 5¼in x 2in. The front panel is 9in x 6¼in. Both chassis and panel were obtained as standard units from one of our advertisers. We did not letter this panel as it is quite simple. This will help to keep the cost down.

Looking at the rear-view photograph, the general placement of components can be seen. At the left rear is the power transformer, with the audio amplifier board immediately behind it. On the front panel and next to the audio amplifier, is the 10K volume control. In the centre of the chassis is the assembly for the local tunable oscillator, with its plug-in coil assembly. Immediately behind this assembly, is the main tuning capacitor, coupled to the tuning



There are only a few components under the chassis. The small board on the right carries power supply components and the aerial balun is at lower left.

NEW 12 AMP. D.C. LOW COST MULTIMETER

Precision measuring by Sanwa—Proven in over 90 countries.

WARBURTON FRANKI now have available a new, medium sized circuit tester featuring 44 microampere meter movement sensitivity. Ideal for testing circuits of radios, television, and other communication equipment.
Input Impedance: 20,000 o.p.v. for DC.
Designed by Sanwa for long, safe operation.
Features: LI and LV scales to check semiconductors. Burnout proof. High voltage ranges are separated from current and resistance ranges. Damage from pulse input voltage will not occur.

Give your equipment the Sanwa test.

Measurement Ranges Available.

DC voltage:	0.3V	1.2V	3V	12V	30V	120V	300V
	1.2kV	6kV	25kV (with probe)				
AC voltage:	6V	30V	120V	300V	1.2kV		
DC current:	60μA	3mA	30mA	300mA	12A (300mV)		
Resistance:	Range ·	×1	×100	×1K	×10K		
	Midscale ·	25Ω	2.5kΩ	25kΩ	250kΩ		
	Maximum ·	5kΩ	500kΩ	5MΩ	50MΩ		
Load current (LI):		60mA	600μA	60μA			
Load voltage (LV):		1.5V	1.5V	1.5V			
Volume lever:	−10∼+17∼+63dB						

FOR FULL DETAILS CONTACT

WF WARBURTON FRANKI

ADELAIDE 56-7333; BRISBANE 51-5121; HOBART 2-1841; LAUNCESTON 31-3300; MELBOURNE 69-0151; MOUNT GAMBIER 2-3841; NEWCASTLE WEST 61-4183; PERTH 8-4131; SYDNEY 29-1111; WOLLONGONG 2-5444.

dial assembly. At the right is the board which contains the first mixer with its plug-in coil assembly, followed by the superregenerative stage, filter and audio preamplifier. Behind this assembly and mounted on the panel, is the 50pF aerial tuning capacitor.

The under-chassis view of the unit shows the layout of components here. The power supply components, except the transformer, are mounted on a wiring board and this is located at the right of the chassis. At the rear left corner is the balun and aerial terminals. On the front skirt is a two-pin speaker socket at the left, with a pair of headphone terminals in parallel with it at the right. The 100 ohm resistor is mounted across these terminals. In the centre is the mains power on/off switch.

Perhaps the best place to start construction would be to make up the various sub-assemblies, etc. This can be followed by assembling these items into the complete chassis-panel arrangement, with only a small amount of interconnecting wiring needed to complete the receiver.

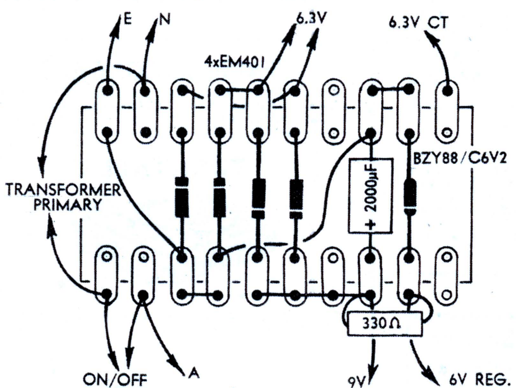


Figure 2

Figure 2. The main power supply board. All the power supply components are accommodated on this board. Make sure that the power flex is connected correctly.

The balun is wound on a small ferrite balun former and can be obtained ready made or you could wind your own. Enamelled 24 B & S copper wire is used and two windings, each having two turns, are wound around the centre core of the ferrite former. The finish of the first winding and the start of the second are joined together and connected to chassis. The other two ends are connected as shown in the circuit diagram.

At this point, we should point out that the balun is only necessary if an aerial having a balanced 300 ohm feedline (such as a standard TV aerial) is to be used. It is simply a matching device to transfer energy from the balanced semi-high impedance aerial into the unbalanced low impedance tap on the aerial coil. If a simple dipole having co-ax feed were to be used, the balun could be omitted and the connection made directly to the tap on the coil. More will be said on the subject of suitable aerials later on.

The tunable oscillator coils (L2) may be wound next. We used two-pin miniature speaker plugs and sockets for the oscillator coils. The coil proper is wound with the two ends running at right angles to the coil and these are terminated by soldering them to the plug pins. The lower frequency coil consists of 7 turns of 22 gauge tinned copper wire, ¼in diameter and spaced to 3/8in long. The high frequency coil consists of 2 turns of 18 gauge tinned copper wire, ¼in diameter and spaced to 3/8in long.

The aerial coils (L1) are wound in a similar manner but using four-pin miniature plugs and sockets. The coil for the range 30 to 70MHz, consists of 8 turns of 18 gauge tinned copper wire, 3/8in diameter and spaced to ½in long. The leads from the ends of the coil are terminated in the two pins with the greatest spacing. The coil is tapped at 2 turns from the earth end and this tap is brought across to one of the remaining pins.

The coil which covers from 70 to 130MHz consists of 4 turns of 18 gauge tinned copper wire, ¼in diameter and 3/8in long. The aerial tap is one turn from the earth end. The coil for 120 to 180MHz consists of two turns of 18 gauge tinned copper wire, ¼in diameter, 5/16in long and tapped at ¼ turn from the earth end.

Coils L3 and L4 are for the output of the mixer and the input to the superregenerative detector, respectively.

Distribution of Stations Between 30 and 250MHz

30-45	**Government services & some mobile channels.**
45-52	**TV channel 0.**
52-54	**Amateur band.**
54-66	**Fixed and mobile.**
56-63	**TV channel 1.**
63-70	**TV channel 2.**
70-85	**Mobile channels including Police, Fire Dept., Ambulance, etc.; aeronautical radio-navigation, plus private industry.**
85-92	**TV channel 3.**
92-94	**Fixed and mobile.**
94-101	**TV channel 4.**
101-108	**TV channel 5.**
108-137	**Government services, including aircraft navigation, aeronautical mobile and space communications.**
137-144	**TV channel 5A.**
144-148	**Amateur band.**
148-174	**Mobile band, includes radio-telephone service.**
174-181	**TV channel 6.**
181-188	**TV channel 7.**
188-195	**TV channel 8.**
195-202	**TV channel 9.**
202-208	**Mobile channels plus aeronautical radio-navigation.**
208-215	**TV channel 10.**
215-222	**TV channel 11.**
222-250	**Allocated to Government use; spasmodic activity.**

TRUSCOTT'S
AUSTRALIA'S GREATEST MAIL ORDER TAPE RECORDER & HI-FI CENTRE

STOCKISTS OFF ALL LEADING BRANDS OF TAPE RECORDERS HI-FI EQUIPMENT, COMPONENT PARTS AND ACCESSORIES

NEAT G30 TONE ARM

The G30, complete with lift-lowering device is a precision built tone arm, outstanding in appearance, and simple to mount, and use in any installation. The results obtainable are far beyond those usually expected from such a moderately priced tone arm. As with all NEAT tone arms, the G30 will accept al lstandard ½in mounting cartridges, including Ortofon and S.M.E. headshells without modification. REVIEWS from the "Gramophone" and "Electronics Australia" are available.

Price (including Sales Tax) **$24.00**

Other outstanding NEAT tone arms available include the G37 Static balance arm, and the revolutionary G32 "Gyrostat" professional arm. Send now for details and reviews.

NEAT CARTRIDGES

V70—A top performance high quality moving magnet cartridge that out performs many more expensive cartridges. Input sensitivity 5mV. Frequency response 20-20,000Hz. Two models are available with replacement type diamond stylus. V70 with conical stylus — V70E with elliptical. When used with the NEAT G30 tone arm, an excellent low cost combination is obtained. Reviews from the "Gramophone" and "Electronics Australia" are available.

Price (including Sales Tax) **$11.25**

If elliptical stylus required add $3.75.

V90—An economical moving magnet model for the budget conscious buyer. Input sensitivity 5mV. Frequency response 20-19,000Hz. Fitted with conical replacement type diamond stylus.

Price (including Sales Tax) **$8.50**

Other outstanding NEAT cartridges available include the V15 "Dynamagnet" and V60 "Induced" Magnet models, and the new V100 "Moving Coil" model complete with special transformers. Send now for details and reviews.

ACOUSTIC SPEAKER GRILLE CLOTHS

Select your speaker grille cloth from the largest range in Australia. Over 60 top-grade cloths now available to choose from. Send now for samples and a very attractive T.M.Q.

SPEAKER ENCLOSURE PADDING

Truscott's are the leading South Australian stockists of Innerbond lining and Bonded Courtelle filling. Ensure dust-free padding for your speaker enclosure. Send for a T.M.Q.

SAVE YOUR RECORDS . . . USE THE UNIVERSAL LUSTRE TONE ARM LIFT

This beautifully finished and functional universal tone arm lift will fit all tone arms, the lowering action is pneumatically dampened and extremely smooth — risk of record damage may now be eliminated.

Price (including Sales Tax) **$8.50**

ACCESSORIES

Microphones and Stands — Tapes and Spools — Splicing Kits — Record Care Accessories — Speaker Enclosure Acoustic Cloth and Inner Baffling — Headphones — Pre-packed Leads — Plugs and Connectors — Head Cleaning Kits — Pillow Phones — Bases and Covers, and Many Others.

Fast Mail Order Service

When ordering, please give your full address printed in BLOCK LETTERS. All Truscott equipment is brand new and fully guaranteed. Sales tax is included in all quoted prices. All orders are despatched promptly. All prices quoted are Nett. Postage and freight extra.
Note. T.M.Q.—Truscott Mail Order Quote.

COMPONENT PARTS

Trustcott's are stockists of all General Electronic components, including resistors, capacitors, plugs and sockets, solder, scope irons and spares, hook-up cables, valves, terminals, tag strips, matrix board, cambric spaghetti, fuses, chassis, grommets, solder lugs, alligator clips, valve sockets, D.I.N. connectors, TV connectors, battery savers, and also a large range of semi conductors for all Japanese makes.

HI-FI TRANSCRIPTION Turntable Combination

Consists of the one and only J.H. Synchronous Turntable, Neat G30 tone arm with lift-lowering device, Neat V70 Magnetic Cartridge, and hand finished oiled TEAK Wooden base with separate plexiglass dust cover.

Price (including Sales Tax) **$85.00**

If assembly required—add $6.00.

HEADPHONE JUNCTION BOX

Elega JB3 Stereo Headphone Junction box with facilities for 2 sets of headphones. You can now add a headset to your amplifier even if it is not fitted with a headphone jack.

Price (including Sales Tax) **$4.50**

STEREO HEADPHONES

A complete range of top brand HI FI Stereo Headphones is available.

Price (including Sales Tax) from only **$7.50**

Models available include:

Ashidavox ST11—8 ohm—20-18,000Hz	$19.50
Elega DR65C—8 ohm—30-15,000Hz	$10.95
Hosiden DH-03S—8 ohms—20-18,000Hz	$8.75
Elega DR66C—8 ohm—25-17,000Hz	$17.50
Kaltro DH-02S—8 ohm —20-12,000Hz	$7.50
Elega DR75C—10K—25-17,000Hz	$19.50

Choose your equipment from the following selection of top brands—and ask for a T.M.Q.

TAPE RECORDERS

Aiwa, Akai, BSR, Incis, Kriesler, National, Philips, Revox, Sony, Tandberg, Tesla, Thorn Atlas, Uher etc.

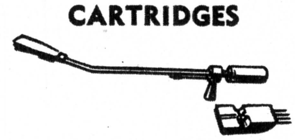
TURNTABLES

BSR, Dual, Goldring, Lenco, JH, Labcraft, PE Thorens, etc.

AMPLIFIERS

Akai, Compax, Cosmos, Kenwood, Leak, Linmark, Monarch, Sansui, Sony, etc.

TONE ARMS AND CARTRIDGES



ADC, All Balance, Audio Technica, Decca, Dual Goldring, Neat, Ortofon, Shure, SME.

SPEAKERS

Akai, Kenwood, KEF, Leak, MSP, Philips, Rola, Soundmaster, Soundwood, Sony, Tesla, Wharfedale.

TUNERS

Compax, Sansui.

DICTATION MACHINES

Agavox, Grundig, Philips.

SLEEP LEARNING EQUIPMENT

All requirements for sleep learning equipment available including Pillow Speakers $4.50. Endless loop tapes $8.86, and Time Clocks $25.00.

TRUSCOTT ELECTRONICS
AUSTRALIA'S GREATEST TAPE RECORDER & HI-FI CENTRE
62-64 HINDMARSH SQ. ADELAIDE, 5000 Phone: 233024 233278

Both are tuned to 27MHz with their associated capacitors. Each coil consists of 12 turns of 24 B&S enamelled wire, wound directly on to the grooves of a 7mm slug, ½in long, of grade 900 Neosid material.

The power supply board is built on a piece of miniature tag board, which accommodates all the components as shown in the wiring diagram of figure 2. The completed assembly will finally be supported on screws through the two holes, one at each end. Meanwhile, a solder lug is screwed over each of these holes and connected to the nearest earth leads on the board. The board is wired into the rest of the set as shown. Points worthy of note are that the centre tap (if any) of the 6.3 volt winding should be terminated as shown. Also points marked "A" (active) and "SW" are taken to the on/off switch. Points "A," "N" and "E" terminate the three leads of the power flex.

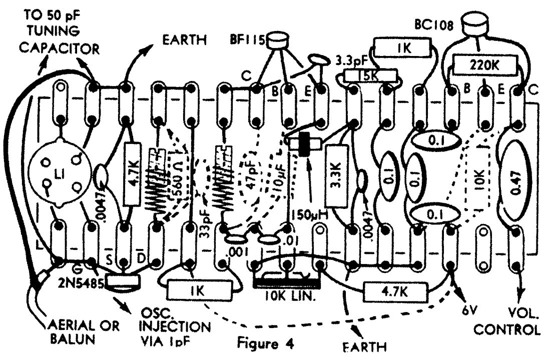


Figure 4. Wiring and component layout for the board accommodating the aerial coil, mixer, supperregenerative detector, and audio preamplifier. A four-pin socket is provided for the aerial coil.

The tunable oscillator assembly is accommodated on a piece of miniature tag board, with eight pairs of tags. This is wired according to the circuit and the wiring diagram of figure 3. It would be a good idea to wire up all the components except the transistor and the 2-pin coil socket. Then drop a 1/8in Whitworth x 1¼in long mounting screw through the hole immediately under where the coil socket is to be placed. Put a solder lug on the screw and under the board and screw a nut down on it. The lug is soldered to the nearest earth point on the board. Provide another identical screw, without a lug, at the other end of the board.

Now wire the socket across the pair of lugs on the board as indicated. To make a solid joint, we suggest that you get some tinned copper wire of about 22 gauge. Thread it through the appropriate lugs on the board and socket. Then solder the joints with a sufficient amount of solder to make a firm joint. The wire will give added strength to the joints, as solder alone may not stand up to the coil changing for very long.

To further support the socket on the board, make two pillars of heavy tinned copper wire and run them through the two holes of the socket normally used for screwing down. The other ends of the pillars are run to the end lugs of the board. Solder the four points and the socket will be quite firm. The transistor is then soldered in.

A large tag board, with 15 pairs of tags, accommodates the FET mixer at one end, followed by the super-regenerative detector, with its low pass filter and the audio preamplifier at the other end. This assembly should be made up carefully and according to the circuit and wiring diagram. Before starting the wiring, two 1/8in Whitworth x 1¼in long screws should be dropped through the third hole from the end near the mixer and the fourth hole from the other end. A nut is run down each screw, after providing a solder lug in each case. Tighten each nut, remembering that the solder lugs must be finally connected to the nearest earth point in each case.

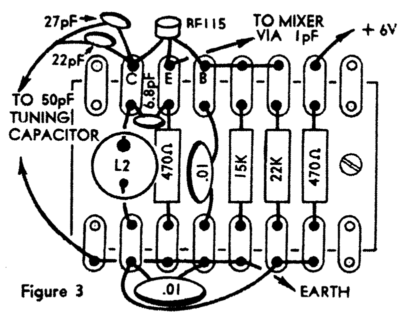


Figure 3. Wiring and component layout for the local oscillator board. A 2-pin socket is provided for the oscillator coil.

Wire up this board in a similar manner to the oscillator unit. A few points are worthy of note and particular care. The two coils, L3 and L4, must be placed as shown in the wiring diagram. Care should also be taken not to distort the windings. The coil socket is fixed and strengthened with wire as before, but only one pillar is used. This runs from the lug on the board, second from the end on the side nearest to the edge of the chassis, to the nearest screw fixing hole on the socket.

The printed board for the audio system has only nine items to be soldered into place and the job is done. The diagram of figure 5 should be followed carefully and a few important points should be observed to ensure success. Make sure that all the electrolytic capacitors are in their correct positions and that correct polarity is observed. When fixing the IC, make sure that it is done with due respect for the correct orientation of the connections. The tag on the IC is between connection 1 and 10 and these should be soldered to the appropriate band of copper on the board. The other connections will automatically be correct.

Although this completes the wiring of the board, it is still necessary to provide a heat sink clip for the IC. We made one up from a piece of aluminium sheet, measuring 2in x ½in. One end was wound around a 5/16in diameter drill and the resulting loop was adjusted by hand so that it was a neat fit over the case of the IC. Although aluminium is excellent for this job, other metals such as brass, copper, or steel would be satisfactory.

At this point we are in a position to carry out the final assembly. The front panel is held to the chassis with the two headphone terminals, the speaker socket and the on/off switch. The dial assembly, volume control and aerial

tuning capacitor are also fixed to the panel. The .01uF capacitor may be wired directly across the volume control. The power transformer may be mounted next. Underneath the chassis, the power supply board is fixed with a pair of 1/8in Whitworth x ½in long screws. By using extra nuts, the board is held off the chassis by about 5/16in.

While the chassis is still upside down, fit the balun. Both aerial terminals must be insulated from the chassis, using the washers provided. The two end leads of the balun are connected to the terminals. The centre tap is terminated on a piece of tag strip, as shown in the picture. Our tag strip has three tags but only one is necessary.

Turning the chassis over, prepare to fix the audio printed board in place. Before doing so fit all leads which are to be run from it. The board is held off the chassis by using a pair of 1/8in Whitworth x 1in long screws, through the holes provided. Nuts are run up to the board and tightened. Another pair of nuts are run on for about ¼in. The screws are dropped through the appropriate holes in the chassis, and two more nuts fitted underneath.

The main tuning capacitor is held in place with a small "L" shaped bracket, 1in wide x 1½in high and with a ½in foot. Two holes are provided in the foot, with three holes (or whatever is necessary) to mount the capacitor at the same height as the bush on the dial drive. With the bracket fixed to the capacitor, the assembly is screwed to the chassis, with the capacitor shaft correctly aligned and engaged in the dial drive bush.

In our case, we used a variable capacitor of Japanese make and the shaft proved to be somewhat less than ¼in diameter. This must be built up to ¼in, by using a piece of shim brass, etc. We did it the easy way, using a length of "sticky tape." Wind some of this tape around the end of the shaft, until it is a neat fit into the bush. This is important for a smooth movement. The grub screws are tightened in the usual way.

Immediately behind the tuning capacitor is the oscillator board. It is held in place and stood off the chassis in the same way as other boards. The mounting should be such that the board is level, centred with the tuning capacitor, and with just enough clearance between them to afford free movement of the rear stator plate.

The board containing the mixer, detector, filter and audio preamplifier is fixed in exactly the same way, with the same remarks applying to the relationship between the board and the aerial tuning capacitor.

With all the main items in place, we have only to do the interconnecting wiring. A good place to start would be the power supply board. Terminate the 6.3 volt leads and the main power flex, not forgetting to clamp it firmly. All other leads to and from the power supply may be run. All other under-chassis wiring may also be done, which includes the speaker and headphone outlets and a small piece of coaxial cable from the balun circuit to the point on the board above the chassis.

The audio leads from the preamplifier to the volume control may be run with a shielded lead but we did not find this necessary. No hum troubles were experienced when we ran a simple twisted pair. A couple of short leads

from the audio board are also run to the volume control.

From the stator and rotor plates of the aerial tuning capacitor run leads in heavy tinned copper wire to the appropriate points adjacent to the coil socket. From the rotor plates of the oscillator tuning capacitor run a similar lead to the appropriate earth point near the aerial coil socket. From the rotor plates, run a 22pF and a 27pF capacitor in parallel to the appropriate lug on the board. A 1pF ceramic capacitor is run from the emitter of the oscillator transistor to the gate of the FET. This completes the wiring.

Before switching on, plug the lowest frequency aerial coil into its socket. Set the detector bias potentiometer to about one-third of its travel from the earth end. Set the slug in L4 about halfway out—this may be adjusted more closely later. Set the rotor of the pre-set potentiometer on the audio board to about one-third of its travel from the input end of the board.

Open the volume control just a little and switch on. Make sure that there are no signs of distress. All being well, you should be greeted with a strong "hissing" or "rushing" sound. This is a sign that the superregen detector is functioning. If this sound is not forthcoming, adjust the rotor on the 10K pre-set potentiometer until this condition is established. Ignore any squeals in the process.

If you have a signal generator, set it to 27MHz, feed it into one of the aerial terminals and adjust L4 until the signal is heard. It may be necessary to make a fine adjustment to the 10K pre-set potentiometer for optimum sensitivity. At this point, you may also adjust the slug in L3 for the best signal, i.e., lowest noise. If you do not have a signal generator leave the L4 slug in the mid position and adjust the slug in L3 on a received signal later on.

If you have a multimeter, set it to a range somewhat above 10mA and insert it in series with the +9 volt lead from the power supply to the audio amplifier. With the volume control right off, switch on and adjust the 25K preset potentiometer so that a quiescent current of 8mA is drawn. Switch off and remove the multimeter.

At this stage we are ready to try the new receiver but it is necessary to provide it with a suitable aerial. This could be anything from an elaborate multi-band TV array to a simple dipole. However, with a simple set of this kind, with limited sensitivity, the aerial plays an important part in the final performance. Use the best you can.

Two home-made TV aerials, having quite good broadband characteristics suitable for this receiver, were described in the November, 1958 issue of the magazine. Copies of the article are available through the query service. (File No. 6/ATV/2). More elaborate aerials, if available, would probably offer some improvement.

If reception is desired around one particular band of frequencies, say, one of the mobile bands or several TV stations closely related in frequency, it would be possible to use a simple folded dipole aerial cut and made according to the instructions in figure 6. This aerial consists of a piece of 300 ohm TV ribbon, with both ends shorted and one lead cut in the centre to connect in another length of ribbon, which acts as a feeder. The length is calculated by dividing the desired frequency in MHz into 55,400. This gives the length of the dipole in inches.

Before we can tune in any signals, we must understand the method of selecting the right set of coils for any frequency range.

To cover from 30 to 70MHz use the largest of the aerial coils. The oscillator must run from about 57MHz to about 97MHz and the larger of the two oscillator coils is used. To tune from 70 to 130MHz use the middle of the three

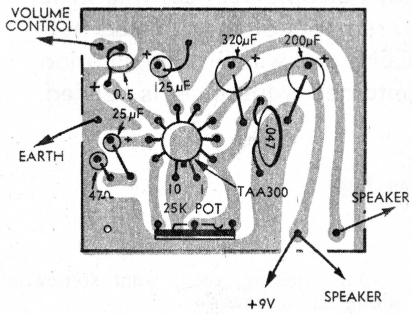


Figure 5. Wiring pattern and component layout of the audio board, as seen from the component side.

aerial coils. The oscillator must now tune from about 97MHz to 157MHz and the smaller oscillator coil is used.

With these first two ranges the oscillator frequency has been to the high side of the wanted signal, by 27MHz. To tune from 120 to 190MHz the smallest of the aerial tuning coils is used, with the same oscillator coil as for the previous example. The oscillator will now be tuned from about 93 to 163MHz, i.e., on the low side of the signal.

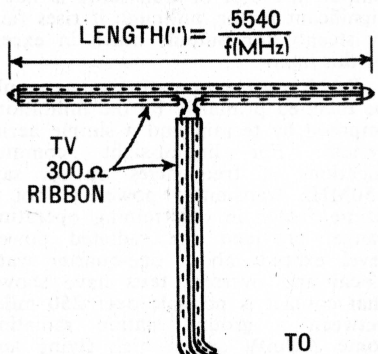


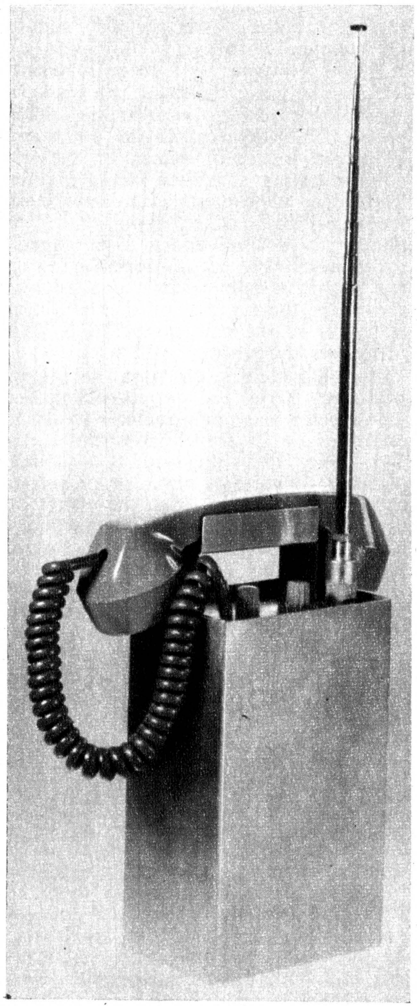
Figure 6. A suggested method of constructing a simple folded dipole for operation over a particular band of frequencies.

A little practice will be required to get the feel of tuning this receiver. Set the aerial or signal tuning capacitor about half way meshed and turn the oscillator tuning until a station is heard. If it is an AM station you can tune to the centre of the carrier. Should it be an FM station (as with the sound on TV channels) you will need to tune slightly off to one side for "slope" detection to occur. Having tuned the signal, you can peak the aerial circuit to give the clearest signal. If necessary, readjust the oscillator tuning slightly as you go.

1-WATT HANDSET FOR THE 52MHz AMATEUR BAND

Developed primarily for amateur portable service, this little 1W handset will meet the requirements of many fixed network operations, including WICEN, and will find application wherever a light-weight, self-contained transceiver is needed.

By Alan Nutt



The completed handset housed in its aluminium case. The cradle for the telephone handpiece also doubles as the carrying handle.

In the six years since we last described a VHF transmitter, the state-of-the-art has changed considerably so that, whereas the choice was almost invariably a valve design even for very low power equipment, the constructor today is faced with the choice of either valve or solid-state design.

Nor is this choice confined any longer to relatively low power levels or, for that matter, to the low end of the VHF spectrum. Provided that price is not the prime design factor, power levels in excess of 50 watts are quite practicable up to the 432MHz band and, even around 2GHz, power levels in excess of 10 watts are possible.

It is not necessary here to list the obvious advantages of solid-state design, particularly in the realm of portable or mobile applications but simply to indicate that the current trend is very much in this direction and that any thought given to the development of equipment of this type must really follow along these lines.

As we specifically had portable operation in mind it was certainly not too difficult to decide in favour of an all solid-state circuit but, even if fixed or base station operation had been envisaged, serious consideration would still have been given to a solid-state design.

Having decided on what was perhaps an obvious course, the next step was to settle on a suitable transmitter power level as this, in turn, would determine largely the overall cost and complexity of the finished article. While it would have been relatively easy to pluck some arbitrary figure out of the air, we felt that closer investigation into the possible uses, cost and weight factors was warranted, so that the final figures would have some firm basis for selection.

It is reasonable to assume that no one design is going to meet every possible requirement, nor will it contain all the facilities which could conceivably be incorporated. The logical approach, therefore, is to aim at a design to meet a specific set of representative conditions and trust that it will thus meet the needs of as representative a body of readers as possible. At the same time we should keep in mind the possibility of modifications or additions which could be incorporated to meet other requirements.

Our thinking, then, went somewhat along these lines.—

SIZE: The set should be as compact as orderly layout would permit. and, in the interests of repeatability, be constructed entirely on a printed wiring board.

WEIGHT: The set should be housed in a light-weight case, strong enough to withstand the rigours of portable use and able to be carried by hand or shoulder strap.

ANTENNA: The antenna should be integral for portable use but removable if necessary, with provision made for connection to an external high-gain beam.

POWER: Transmitter antenna power should be limited to 1 watt mainly in the interests of battery economy and minumum weight. Up to 3 or 4 watts output, the cost of transistors is not a significant factor, although it rises fairly steeply for outputs much in excess of this figure.

RANGE: The operating range would be dictated primarily by the limitations imposed by terrain and a simple aerial system. For line-of-sight communications at frequencies up to, say, 150MHz transmitter power is not a prime factor in determining operating range, provided the radiated power level exceeds about one-quarter watt. Local and overseas tests have shown that contact is possible over 250 miles between a ground station radiating some 300mW and a high flying aircraft at 35,000 feet.

SUPPLY: Power should be provided from an internal source with provision for connection to an external supply if required.

It is not a difficult matter to provide a suitable 12V battery pack using easily obtainable dry cells and we considered this to be the simplest approach. At the same time we recognised that some applications might call for extended life types such as alkaline or mercury cells or even, where specifically warranted, rechargeable nickel-cadmium packs.

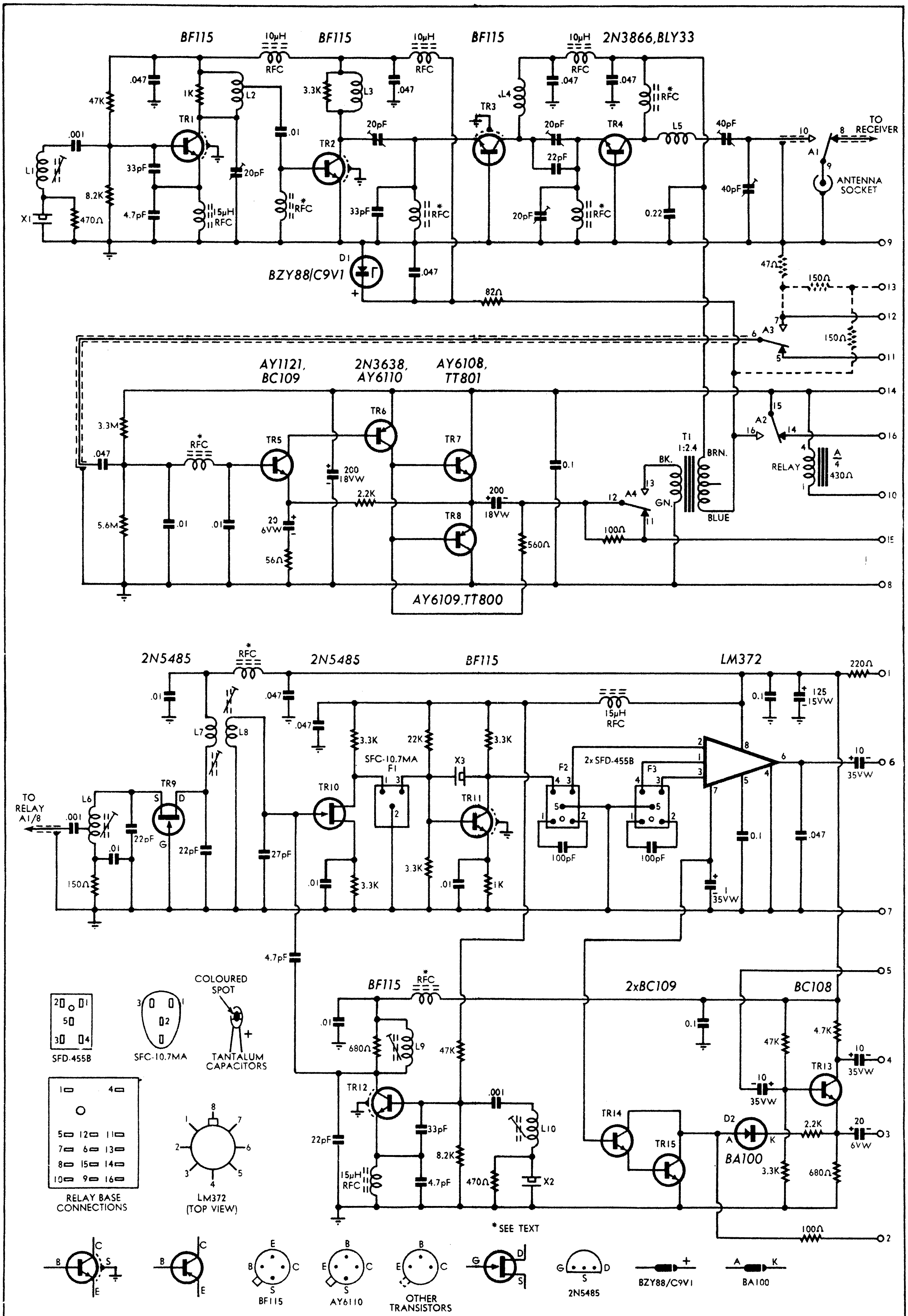
Most of the transistors designed for higher power levels require supply voltages of 24V or more. This raises the problem of a suitable battery pack with its attendant cost, weight and ease of replacement. On the other hand, there is a considerable number of transistors capable of handling a power level of 1 or 2 watts when operated from a nominal 12V supply.

It must be appreciated, however, that the initial cost of a suitable rechargeable pack, with charger, is not going to leave much change out of $50. Coupled with this is the relatively low power/weight ratio compared to the non-chargeable types, a factor worth considering if the equipment is to be carried for any length of time.

Alkaline cells, while considerably cheaper, are still not a practical proposition unless the equipment is to be given a lot of use. For the casual user, ordinary transistor radio cells are adequate, since the maximum current drain is about 250mA on modulation peaks and only about 25mA on receive.

FREQUENCY: Operating frequency, while a matter for individual choice, must be selected with local operating conditions in mind. In our case the local AM net frequency of 53.866MHz seemed to be the logical one to settle upon.

While the receiver would initially be tuned to the selected net frequency, provision should possibly be made for conversion to tunable operation. While low noise and high sensitivity are highly desirable characteristics in VHF equipment, bearing in mind the type of operation intended for our handset, the



52MHz HANDSET (FIXED FREQUENCY)

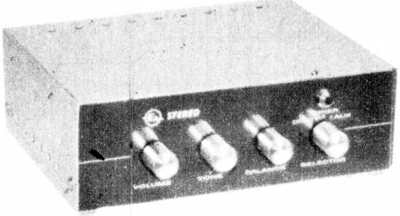
INSTROL ELECTRONICS

Everything for hobbyist and technician

PLAYMASTER KITS

STEREO AMPLIFIERS

(postage $1.80 extra)



Playmaster No. 3	$60.50
Playmaster No. 4	$83.30
Playmaster No. 106	$106.15
Playmaster No. 113	$64.60
Playmaster No. 115	$96.80
115 Magnetic Preamp	$10.50
Playmaster No. 118	$89.60
118 Magnetic Preamp	$16.15
E.A. 3 plus 3	$43.50
E.A. 10 plus 10	$62.75
Playmaster 124 gram	$67.70
Playmaster No. 128	$99.40

CONTROL UNITS

(postage $1.20 extra)

Playmaster No. 112	$44.00
—Preamp "A"	$9.00
—Preamp "B" or "D"	$6.00
—Preamp "C"	$9.00
Playmaster No. 120	$44.40
Playmaster No. 127	$49.85

TAPE ADAPTOR

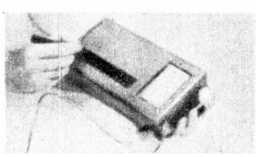
(postage $1.80 extra)

Playmaster No 119	$87.03

MISCELLANEOUS

(postage $1.20 extra)

Playmaster 111 tuner	$39.00
111 Power Supply	$9.40
111 Whistle Filter	$7.80
Fuzz Box (Aug. 67)	$12.95
Musicolour (post. $1.80)	$46.05
Keyless Organ	$35.10



GUITAR AMPLIFIERS

(postage $1.80 extra)

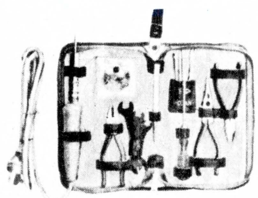
Playmaster No. 116	$84.35
Playmaster No 117	$92.30

PRINTED CIRCUITS

(extra 20c postage and packing)

Playmaster No 110	$3.20
Playmaster 112, 65/P12A	$2.50
65/P12B	$2.50
Playmaster No. 113	$3.00
No. 115 Crystal preamp	$2.00
Magnetic preamp	$1.60
Left channel	$1.60
Right channel	$1.60
Playmaster No. 119	$2.50
Playmaster No. 120	$2.50
Playmaster No. 123	$3.20
No. 124 amplifier	$2.50
Tuner	$2.50
Playmaster No. 125	$2.50
Playmaster No. 127	$2.50
Playmaster No. 128 ... each	$2.50
Powered loudspeaker (9-69)	$1.25
Magnetic preamp (10-65)	$2.50
Musicolour	$2.50
Stereo three plus three	$2.50
Stereo 10 plus 10	$2.50
Keyless Organ (gold)	$5.00
Keyless Organ (nickel)	$3.50
F.E.T. Voltmeter	$2.30
Blank 4 x 2, 3 x 3 or 4 x 3	.20
Blank 6 x 3	.25
Blank 6 x 4	.30
Blank 6 x 6	.45
Blank 12 x 3	.50
Blank 9 x 6	.60
Etching kit	$1.15

TOOLS



Instrol Tool Kit ($1 post.)	$12.50
Adel hand nibbler (30c post)	$5.75
Chassis Punch Set 5RB ($1 post).	$7.00
Adcola M64 Sold. Iron (30c post.)	$6.50
Craftsman 30W Iron (30c post.)	$4.20

DIECAST INSTRUMENT CASES

4½ x 3 x 1 (post. 20c)	$2.19
4½ x 3 x 2 (post 35c)	$2.76
6½ x 4½ x 2 (post. 60c)	$3.81

PLASTIC INSTRUMENT CASES

6 x 3 x 2 (post. 20c)	$1.32
5 x 2½ x 1½ (post. 25c)	.75

LABELS

(post. 20c, reg'n 25c extra)

Playmaster No. 2	$2.00
Playmaster No. 3	$2.00
Playmaster No. 4	$2.00
Control Unit No. 9	$2.00
Control Unit No. 10	$2.00
Playmaster No. 102-103	$2.80
Playmaster No. 104	$2.00
Playmaster No. 105	$2.00
Playmaster No. 106	$2.80
Playmaster No. 107	$2.80
Playmaster No. 108	$2.80
Playmaster No. 110	$4.00
Playmaster No. 111	$2.80
Playmaster No. 112	$2.00
Playmaster No. 114	$2.80
Playmaster No. 115	$2.00
Playmaster No. 116	$2.80
Playmaster No. 117	$2.80
Playmaster No. 118	$2.80
Playmaster No. 119	$3.40
Playmaster No. 120	$2.00
Playmaster No. 123	$2.80
Playmaster No. 124	$2.00
Playmaster No. 125	$4.50
Playmaster No. 127	$2.00
Stereo 3 plus 3	$2.00
Stereo 10 plus 10	$2.00
Musicolour	$2.00
Fuzz Box	$1.20

METALWORK

Write in for free catalogue on INSTROL high-quality metalwork and chassis for "Electronics Australia" designs.

HOWARD SAMS BOOKS

(add 15c packing and postage)

Using Scopes In Transistor Circuits	$5.45
Troubleshooting With The Oscilloscope	$3.40
Know Your Oscilloscope	$3.40
101 Ways To Use Your Oscilloscope	$4.05
101 More Ways To Use Your Scope In TV	$4.05
A.B.C.s Of Transistors	$3.20
101 Ways To Use Your Signal Generator	$4.03
Radio Receiver Servicing	$5.18
TV Diagnosis And Repair	$2.25
Transistor Substitution Handbook	$3.05
Practical Power Supply Circuits	$4.05
49 Easy Transistor Projects	$2.70
RCA, Transistor, Thyristor and diode Manual	$2.50
ABC's of Vacuum Tubes	$3.40
Electronics for Beginners	$6.05
101 Ways to use your Hi-fi Test Equipment	$3.40
Hi-fi Stereo Handbook	$6.35
ABC's of Transformers and Coils	$2.90

INSTROL ELECTRONICS CENTRE 91a York St. (between King & Market St.)

PHONE 29-4258 SYDNEY N.S.W. 2000

for descriptive leaflet post coupon

☐ Playmaster
☐ Toolkit
☐ Microphone
☐ Metalwork
☐ Technical Books
☐ Capstan Cabinets

Please include postage stamp.

Name . . . .

Address . . . .

Postcode . . . . .

design must be kept simple, consistent with good performance. (After all, it is not the type of equipment one would normally use to break a VHF DX record).

SQUELCH: Squelch and call tone could be provided but easily deleted if the facility was not required.

So much, then, for our initial planning. We come now to a detailed consideration of the final design.

Looking first of all at the transmitter section, a BF115 (Tr1) functions as an overtone oscillator, the crystal operating in its series mode in the base-emitter circuit. The collector tank is tuned to the crystal frequency, which, in this case, is the local metropolitan AM net frequency of 53.86MHz. The collector tuned circuit is damped by a parallel 1K resistor, mimimising the possibility of spurious ocillation at other than the crystal frequency.

The output from the oscillator is capacitively coupled from a tap on the collector tank to the base of the BF115 amplifier, Tr2. This stage normally functions without any fixed bias.

Both the oscillator and buffer amplifier stages operate at a supply potential of 9V, regulated by the zener diode, D1.

The BF115 driver stage, Tr3, is a grounded base amplifier and realises somewhat more power gain in this configuration as well as being inherently more stable. The emitter is driven from the preceding buffer amplifier via a fixed capacitive matching network.

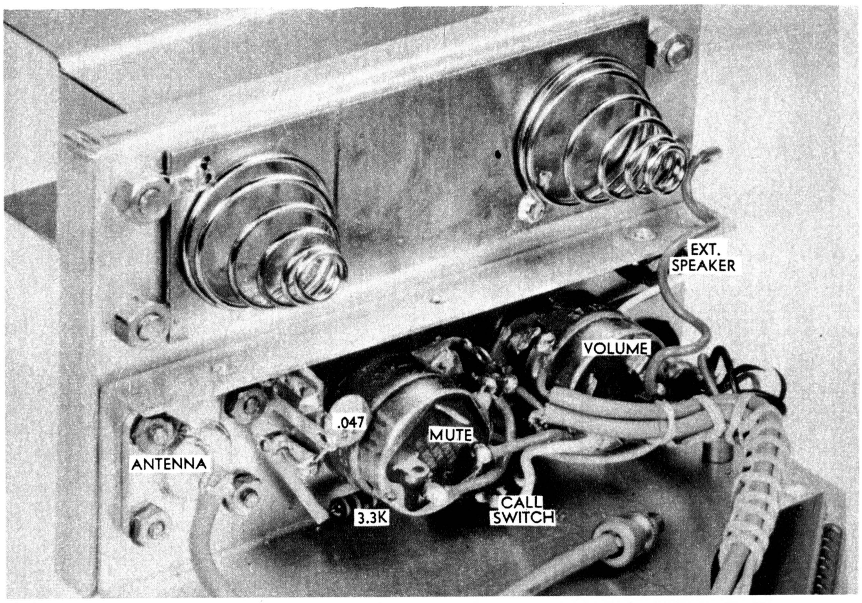
The importance of correct impedance matching cannot be too strongly emphasised if maximum efficiency is to be obtained. For this reason, both input and output tank circuits of the BLY33 power amplifier stage, Tr4, are adjustable so that an optimum match might be achieved. A network similar to the driver stage input is used for Tr4 but, in this case, both capactive elements are adjustable.

The power amplifier stage is also operated in a grounded base configuration. It should be noted that the collector is tied electrically to the case so that, if a heat sink is fitted, care should be taken to see that no accidental shorting can occur to other components. The collector tuned circuit is series resonant at the operating frequency and again an adjustable capacitive network permits an optimum impedance match into the antenna load.

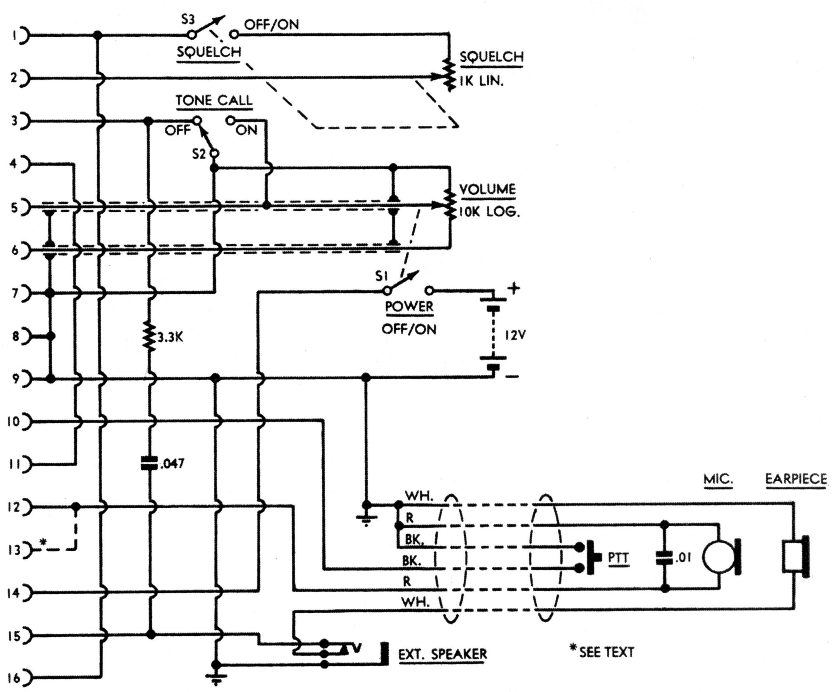
In the interests of good linearity, modulation is applied to both the driver and PA collectors. In some VHF designs it has been found advantageous to apply modulation to the last three amplifier stages but it was found unnecessary in this case.

The modulator, which also functions as the receiver output stage, utilises a design in which the number of components is kept to a minimum although the power output can be in excess of 1 watt. Although normally working into an 8-ohm load without the use of transformer coupling, it is necessary to use a transformer when functioning as a modulator in order to correctly match the load presented by the BLY33 PA stage.

The sensitivity of the modulator is determined in the main by the degree of negative feedback applied to the emitter of Tr5 and this in turn is controlled by the value of the resistor in series with the 20uF capacitor between emitter and ground. With this resistor



All the components external to the printed board are pictured above, the necessary connections from the 16-way socket being shown below. The method used to assemble the battery contact springs is also shown in the photograph.



around 56 ohms, the sensitivity is high enough to permit the use of a rocking armature type microphone. Improved speech quality is possible with this type, compared with the usual carbon insert.

We did make provision for the use of a carbon microphone if required, the additions necessary being shown dotted across plug contacts 9, 12 and 13. The three resistors are listed as optional in the parts list.

A simple resistive divider across the microphone compensates for the higher output of a carbon type. This method of attenuation was selected rather than an increase in negative feedback to Tr5, permitting the full sensitivity to be realised in the "receive" condition.

Passing on to the receiver, the design is straight forward although there are a number of features worth noting.

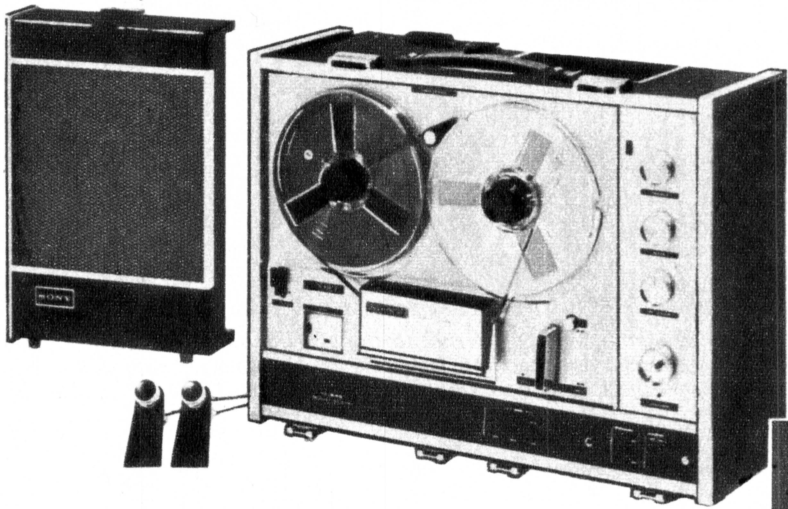
Basically, the receiver is a single frequency, double conversion superhet with first and second intermediate frequencies of 10.7MHz and 455KHz respectively.

Both the first and second IF stages use fixed frequency ceramic filters making alignment of these sections of the receiver unnecessary. At the same time, use of a fixed first IF precludes the use of a single crystal oscillator being used to supply injection to both the first and second mixers.

The single crystal approach is usually chosen in the interests of economy. The crystal oscillator is selected to supply fundamental frequency injection into the second mixer and a suitable harmonic into the first mixer to obtain the higher first IF. With the signal frequency and second IF fixed, and the oscillator multiplication only in whole

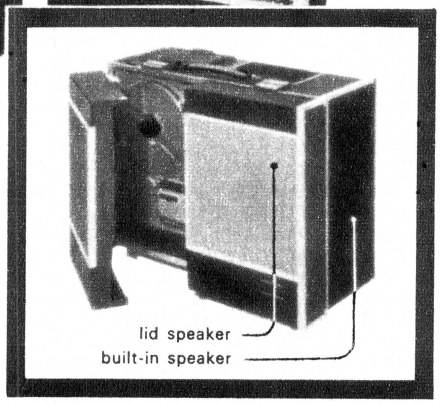
Quadradial sound system

(2-way, 4 speakers)



You get the ultimate in stereo realism with

SONY TC-540



The **ultimate** in stereo performance is yours from SONY's quality solid-state tape recorder TC-540 with 4-track stereo/mono recording and playback operation. 'Quadradial' sound system comprises uniquely designed separate speakers and individual bass and treble controls for personal tone preferences.

***SPECIFICATIONS*—Recording system:** 4-track stereo/mono recording and playback. **Power requirements:** AC 50/60 Hz, 220 or 240V, 65 watts. **Tape speeds:** $7\frac{1}{2}$ ips, $3\frac{3}{4}$ ips, $1\frac{7}{8}$ ips. **Reels:** 7" or smaller. **Freq. response:** 30-20,000 Hz at $7\frac{1}{2}$ ips, 30-13,000 Hz at $3\frac{3}{4}$ ips, 30-10,000 Hz at $1\frac{7}{8}$ ips. **Flutter and wow:** 0.09% at $7\frac{1}{2}$ ips, 0.12% at $3\frac{3}{4}$ ips, 0.16% at $1\frac{7}{8}$ ips. **Harmonic distortion:** 2%. **S/N ratio:** 50 dB. **Output:** 5W per channel (20W total dynamic power). **Speakers:** Two built-in speakers 4" x 8" and two lid-integrated speakers 4" diameter. **Recording time (1800' tape):** 4-track stereo 6 hrs. at $1\frac{7}{8}$ ips, 4-track mono 12 hrs. at $1\frac{7}{8}$ ips. **Fast forward and rewind time:** Within 2 min. 20 sec. (1200' tape). **Inputs:** MICROPHONE Sensitivity 72 dB (0.19 mV). LINE Sensitivity −20 dB (0.078V). **Outputs:** LINE Sensitivity 0 dB (0.775V). EXTERNAL SPEAKER Sensitivity 11.2 dB (2.83V). MONITOR Sensitivity 11.2 dB (2.83V). **Rec/PB connector:** INPUT Sensitivity 40 dB (7.8mV). OUTPUT Sensitivity 0 dB (0.775V). **Dimensions:** $19\frac{11}{16}$ (W) x $9\frac{15}{16}$ (H) x $15\frac{7}{16}$ (D). **Weight:** 41 lbs. 10 oz.

Schools to win
SONY TC-540's
a valuable aid for students' education

In conjunction with the Channel 7 Network the fifteen finalist schools in "It's Academic" will each be presented with a SONY TC-540 stereo tape recorder.

SONY®
Distributed by:
JACOBY MITCHELL

SYDNEY—26 2651 • MELBOURNE—30 2491/2 • ADELAIDE—53 6117 • BRISBANE—2 6467 • PERTH—28 8102 • LAUNCESTON—2 5322 • Agents: CANBERRA—47 9010 • N'CLE—61 4991 • PORT KEMBLA—4 2071.

To: **Jacoby, Mitchell & Co. Pty. Ltd.,** 467-475 Kent St., Sydney, 2000.
Please send me information on the Sony TC-540 Stereo Tape Recorder.

NAME ....

ADDRESS ....

.... JMS/10-70 EA570

numbers, the only variable is the first IF and this calls for the use of an adjustable tuned circuit.

A brief look at the following calculation will make this obvious and, at the same time, indicate the means whereby this method can be used if required.

Assuming that both oscillator injection frequencies are to be on the low side of the signal and first intermediate frequencies, the formula may be used:

$$a = \frac{f + nb}{(1+n)}$$

where:

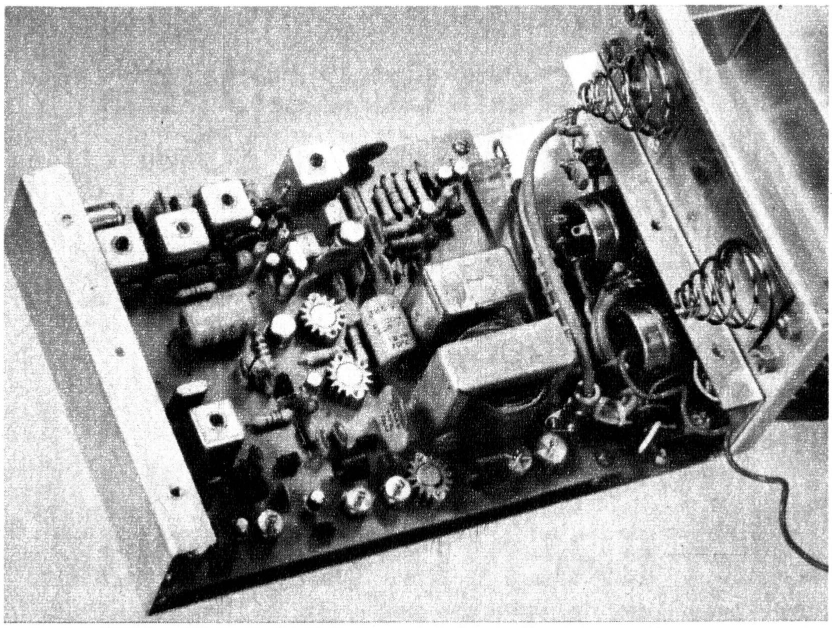
a is the first IF

b is the second IF

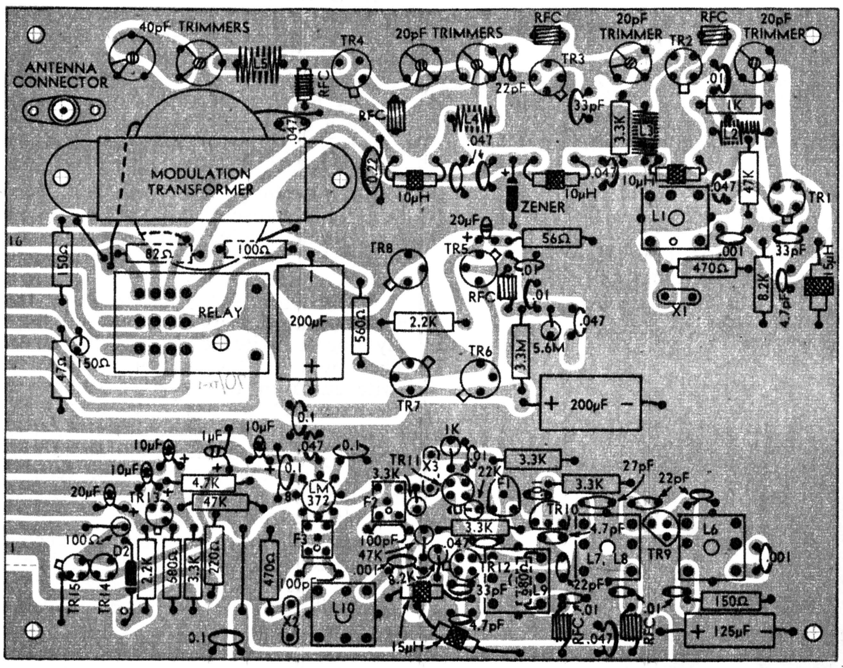
f is the signal frequency

n is the oscillator multiplication factor to arrive at the first mixer injection frequency.

A signal frequency of 53.866MHz, second IF of .455MHz and a multiplication factor of, say, 4 will produce a



The assembled board and associated controls are pictured above. The heat sinks fitted to the modulator transistors are optional. A component layout diagram is included below to assist in the mounting of the various items on the board.



first IF of 11.137MHz with a crystal oscillator frequency of:

$$(a - b) = 10.682\text{MHz}$$

From this it is obvious that any change in "f" will cause a corresponding change in both "a" and the crystal oscillator frequency (a — b).

As suggested, it is not possible to use a fixed frequency coupling element if this method is employed and a tuned coupling transformer is provided in a practical design, even if no incoming signal frequency change is contemplated. In addition, a multiplier stage is required to follow the oscillator in order to select the required harmonic for injection into the first mixer.

While our approach may be slightly more expensive, it is perhaps the more flexible method and makes for very simple modification to fully tunable operation, a change which we want to present at a later date.

Returning now to the circuit, a FET RF amplifier, Tr9, is used in the grounded gate configuration, transformer coupled through L7 and L8 to a grounded source mixer, Tr10.

The HF oscillator is similar to that used in the transmitter section, the design of the collector tank being slightly different. Oscillator voltage is injected via a 4.7pF capacitor into the gate of Tr10. The oscillator is on the low side of the signal frequency and produces a first IF of 10.7MHz at the drain of the mixer.

The IF signal is coupled through a wideband ceramic filter (F1), centred on 10.7MHz, to the base of the self-oscillating second mixer, Tr11. A 10.245MHz crystal connected between the collector and base of this stage, provides the required injection signal to produce a second IF of 455KHz.

The second IF of 455KHz is selected at the collector of Tr11 and passed through a 455KHz ceramic filter (F2) to a linear operational amplifier, LM372. A further filter (F3) is used as an inter-stage coupling element between sections of the op-amp to provide additional selectivity.

In addition to operating as an IF amplifier, the LM372 also acts as an active AM detector, providing a small measure of audio gain after detection. An AGC voltage is available at pin 7 and is used for internal control within the device.

The audio output is coupled through a 10uF capacitor to the volume control mounted on the top panel and thence to the squelch gate amplifier, Tr13. With squelch control switch, S3, turned off, Tr13 operates as a normal AF amplifier feeding into the main audio amplifier/modulator stage already described.

When switch S3 is closed, a positive voltage is fed via the 1K squelch control and diode D2 to the emitter of

YOU WILL NEED THESE PARTS:

TRANSMITTER AND MODULATOR

3 BF115
1 BLY33
1 BC109
1 TT3638 or AY6110
1 TT800 or AY6109
1 TT801 or AY6108
1 15-ohm/84-ohm 1W output transformer (TRS 215 or similar)
1 4-pole, change-over contact relay (Varley VP4/CBB/21 or similar)
1 BZY88/C9V1 zener diode.
4 20pF trimmer capacitors (Philips 2222 808 00006)
2 40pF trimmer capacitors (Philips 2222 808 91503)
3 10uH peaking chokes
1 15uH peaking choke
4 FX1115 or FX1242 ferrite beads (Mullard)
1 5mm coil form (Neosid 722/1, base, can and F29 slug)
1 Miniature co-ax socket (Belling Lee L1465/FS/AG/NI)
1 5th overtone crystal (X1), carrier frequency (Hy-Q QC25 or Pye Q16)
1 5mm iron-dust slug (Neosid grade 500)

RESISTORS
(All ½W unless noted)

1	47 ohm (optional, see text)	1	560 ohm
		1	1000 ohm ⅛W
1	56 ohm	1	2.2K
1	82 ohm	1	3.3K ⅛W
1	100 ohm	1	8.2K
2	150 ahm (optional, see text)	1	47K
		1	3.3M
1	470 ohm	1	5.6M

CAPACITORS

1	4.7pF NPO	4	.01uF 25V disc
1	22pF NPO	6	.047uF 25V disc
2	33pF NPO	1	.1uF 25V disc
1	1000pF disc	1	.22uF 25V disc
1	20uF 6V tantalum		
2	200uF 18V electrolytics		

RECEIVER

2 2N5485
2 BF115
2 BC109
1 BC108
1 National operational amplifier type LM372.
1 BA100 diode.
1 10.7MHz ceramic filter (Murata SFC-10.7MA)
2 455KHz ceramic filters (Murata SFD-455B)
4 5mm coil formers, base, can and F29 slug (Neosid 772/1)
2 FX1115 or FX1242 ferrite beads (Mullard)
2 15uH peaking chokes
1 10.245MHz crystal, (X3), Hy-Q QC25 or Pye Q16)
1 3rd overtone crystal, (X2), Hy-Q QC25 or Pye Q16, f(MHz)-10.7MHz

RESISTORS
(All ½ W unless noted)

1	100 ohm	4	3.3K
1	150 ohm	2	3.3K ⅛W
1	220 ohm	1	4.7K
1	470 ohm	1	8.2K ⅛W
1	680 ohm	1	22K ⅛W
1	680 ohm ⅛W	1	47K
1	1K ⅛W	1	47K ⅛W
1	2.2K		

CAPACITORS

2 4.7pF NPO
3 22pF NPO
1 27pF NPO
1 33pF NPO
2 100pF 100V styro
2 1000pF disc
5 .01uF 25V disc
4 .047uF 25V disc
3 .1uF 25V disc
1 1uF 35V tantalum
3 10uF 35V tantalum
1 20uF 6V tantalum
1 160uF 16V electrolytic

ACCESSORIES

1 Case, chassis, battery panel and carrying handle.
1 P/C board, 70/Tx-1
2 Pieces P/C board for battery compartment
3 Battery springs
3 Battery tubes
1 1K lin taper potentiometer with SPST switch
1 10K log. taper potentiometer with SPST switch
1 Miniature SPDT toggle switch
1 Co-axial socket (SO-239)
1 Co-axial plug (PL-259)
2 Knobs
1 Handset assembly with ptt button (Weston Electronics)
1 3.5mm break contact phone jack
1 Miniature co-axial plug (Belling Lee L1465/FP/AG/NI)
1 Telescopic aerial, 54in minimum extended length
1 ⅜in grommet
1 ¼in grommet
1 3-lug tag strip
1 16 way P/C edge connector, .15in contact spacing (McMurdo)
1 Heat sink suit TO-5 case.
Hookup wire
12in shielded wire
16in small diameter co-axial cable, 50-ohm
20, 25 and 28 SWG enam. wire
7 ¼in brass spacers, tapped ⅛inW
Screws, nuts, PK screws, solder lugs

SPECIAL COMPONENTS

RELAY: Associated Controls Pty. Ltd., 14 Enterprise Ave., Padstow, N.S.W., 2211

FILTERS: I.R.H. Components Pty Ltd., The Crescent, Kingsgrove, N.S.W., 2208.

TRIMMERS: Philips "Miniwatt" Division, 67 Mars Rd, Lane Cove, N.S.W., 2066.

CRYSTALS: Pye Crystal Division, P.O. Box 105, Clayton, Vic., 3168. Hy-Q Electronics Pty. Ltd., P.O. Box 256, Frankston, Vic., 3199

HANDSET: Weston Electronics Pty. Ltd., 376 Eastern Valley Way, Roseville, N.S.W., 2069.

FERRITE BEADS: Mullard (Aust.) Pty. Ltd., 35-43 Clarence St., Sydney, N.S.W., 2000.

COIL FORMERS and SLUGS: Watkin Wynne Pty. Ltd., 32 Falcon St., Crow's Nest, N.S.W., 2065.

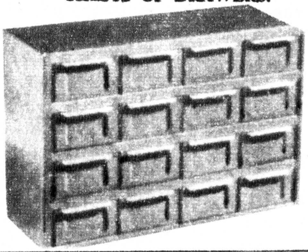
CHEST OF DRAWERS

Three types of Galvanised Chests measuring 17⅛in x 6¾in x 11⅞in, containing 16 drawers, each measuring 6⅝ x 3¾in x 2⅛in.

- TYPE C.D.1. With 16 undivided drawers.
- **TYPE C.D.2. With 16 triple compartment** drawers.
- **TYPE C.D.3. With 8 triple compartment** drawers, and 8 undivided drawers.
- TYPE C.D.4. A 17⅛in x 11⅞in Galvanised Chest containing 4 full-length dawers each measuring 15¾in x 6⅝in x 2½in.

The Chests are finished in blue hammertone stoving enamel, are complete with identification cards and packed in strong corrugated cartons. Provision is made for all units to be bolted together in tiers.

WRITE FOR FREE CATALOGUE AND PRICE LIST OF TOOL BOXES AND CHESTS OF DRAWERS.

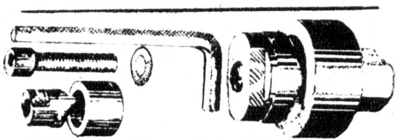


COLOUR TELEVISION

With particular reference to the PAL system by G. N. PATCHETT

This book now available

$5.95



"PIPGRAS" HOLE PUNCHES

"PIPGRAS" Hole Punches are made from Alloy Tool Steel, and cut clean and accurate holes in sheet metal. They make a smooth, perfect hole without reaming or filing.

SCREW TYPE, ROUND

Supplied with "UNBRAKO" High Tensile Socket Screws and Wrenches. Cut holes in sheet metal up to 18 gauge.

Type No.	Nominal Size	Actual Size	Water Pipe Size (I.D.)	Pilot Drill Size	Price Each
32.S	½in	0.507in	—	¼in	$2.17
40.S	⅝in	0.618in	¼in	5/16in	$2.17
48.S	¾in	0.742in	⅜in	5/16in	$2.80
56.S	⅞in	0.884in	½in	⅜in	$3.80
64.S	1in	1.008in	—	⅜in	$4.10
72.S	1⅛in	1.133in	¾in	⅜in	$4.53
76.S	1 3/16in	1.172in	—	⅜in	$4.53
80.S	1¼in	1.258in	—	⅜in	$4.97
88.S	1⅜in	1.382in	1in	7/16in	$5.97

With Heat Treated, High Tensile Steel Hex. Head Bolt and Nut.

Cut holes in sheet metal up to 16 gauge.

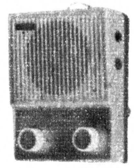
96.S	1½in	1.512in	—	9/16in	$6.68
112.S	1¾in	1.762in	1¼in	9/16in	$7.60
128.S	2in	2.014in	1½in	9/16in	$8.33

BELLPHONE

Pick up the receiver and dial push number desired.

Large $13.50 per pair
Small $10.12 per pair

KALTRO SVC TV-RADIO REMOTE CONTROL LISTENER



This TV-Radio Remote Control Listener is a combination of an extension speaker and a remote control station to regulate the sound of both the TV, Radio, Phono, or Hi-Fi set and the speaker incorporated in the Listener itself. In addition, up to two earphones can be attached for listening to the sound of the TV, Radio, Phono, or Hi-Fi set without disturbing others around you. Unwanted commercials can be easily cut off by merely turning down the control of the TV-Radio Remote Control Listener. A modern designed plastic cabinet with easily adjustable fingertip controls ideal for use in home, office and business. Complete with earphone, 20ft of lead wire and installation instructions.

Price $8.75

Trade enquiries prices available on application

★

Free parking at Rhodes

★

Phone:
73-0211 Rhodes
29-4451 City
73-5586 Sat. Morning.

THIS MONTH'S SPECIALS

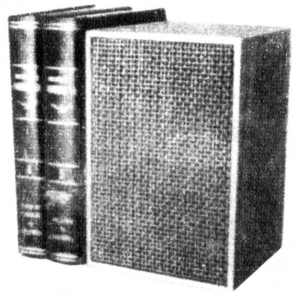
Radar 1XR Power Supply	$30.60
Radax 05XR Power Supply	$20.40
Lapel Microphone X67 ..	$00.90
Table Microphone BM3 ..	$ 7.50

8 WATT STEREO AMPLIFIER MODEL SA-80S

SPECIFICATIONS

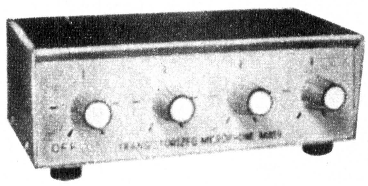
Output Power: 8 Watt, 4 Watts per channel.
Frequency Response: 60 to 15,000 cps. plus or minus 1 db.
Harmonic Distortion: Less than 3%.
Hum and Noise: 52 db below rated output.
Sensitivity: Phone (Crystal) 100mV 250K ohm.
Tuner 100mV.
Tube Complements: 12AX7x1, 30A5x2, 1S315x1 (Silicon Rectifier).
Dimensions: 5.1lb. 9¾in x 6¼in x 3in.

BOOK SHELF TYPE SPEAKER SYSTEM MODEL SP-4S



Speaker: 4in, 8 ohms.
Frequency Response: 70-13,000 cps.
Sensitivity: 93dB.
Power Input: 8W (Music Power).
Cabinet Size: 9⅞in (H) x 6¼in (W) x 5⅞ (D).
Finish: Walnut lacquer.

FOUR CHANNEL TRANSISTORISED MICROPHONE MIXER



All four inputs accept standard two circuit Phone Plugs, while the output jack accepts a standard circuit Phone Pin Plug.

SPECIFICATIONS:

● Input Impedance: "Hi" Impedance for Crystal Microphone, etc. ● Gain: Approximately 6 db. ● Maximum Input Signal: 1.5 volts. ● Maximum Output Signal: 2.5 volts. ● Output for Minimum Distortion: 2 volts. ●Hum: 0. ● Battery: 9 volts.

GENERAL ACCESSORIES

(A DIVISION OF ELECTRONICS INDUSTRIES)

116-118 CLARENCE ST., SYDNEY 29-4451   443 CONCORD RD., RHODES 73-0211

BOTH STORES OPEN SATURDAY MORNING   FREE PARKING SPACE AT RHODES FOR CUSTOMERS

ever, that in making a substitution, the transistor chosen should have a minimum BVces of 55V if full modulation is to be applied.

A number of RF chokes have been employed, those in the 12V supply line being 10uH video peaking chokes. The chokes used in the emitter circuit of both the transmitter and receiver oscillator stages are 15uH peaking chokes. All the remainder, with the exception of the BLY33 collector choke, comprise six turns of 28 B&S enamel wire wound in toroidal form on a small ferrite bead, Mullard type FX1115 or FX1242.

The PA collector choke consists of 15 turns of the same enamel wire wound in the threads of a 5mm iron-dust core, Neosid grade 500.

One of the most important factors governing stability in a circuit of this type is correct bypassing and decoupling. It is common practice to use feedthrough-type capacitors as bypasses at VHF because of their low series inductance. However, we have found, particularly when used in printed circuits, that disc-type capacitors perform satisfactorily at least as high as the 144MHz band. It is essential of course that the lead length be kept to an absolute minimum.

The modulation transformer has a turns ratio of 2.36:1. This could be increased as high as 3.6:1 with an improvement in modulator sensitivity but this value was not available as an "off-the-shelf" item and the transformer specified in the parts list performed quite satisfactorily. The orignal primary centre tap was not used, the lead being cut off short.

The change-over relay is a standard miniature 4-pole, change-over type and is available in a variety of coil voltages and contact materials. Manufacturers include ITT, Siemens and Varley.

We used a coil nominally specified for 21-volt operation but performing satisfactorily down to something below 9 volts. The coil resistance is 430 ohms as against 230 ohms for a 13-volt coil, thereby effecting a worthwhile saving in battery drain. Although we used a relay with standard connecting lugs, special types are available to order for direct printed circuit mounting, having pre-tinned lugs. The Varley code is modified to VP4 PCB/CBB/21.

While in our prototype we used a standard phenolic printed board, there may be some justification in specifying a fibre-glass board under certain circumstances. If the equipment is likely to be subjected to rough handling, the extra strength of a fibre-glass board may be a worthwhile advantage. At least one manufacturer has indicated his willingness to produce either a phenolic or fibre-glass board as requested, although the cost is somewhat higher in the latter case.

We located a very satisfactory telephone handset for use with our set, having an integral push-to-talk button, dynamic low impedance ear-piece and a choice of either rocking armature or carbon microphone inserts. Available at a cost around $10, we considered it a good proposition although, here again, the ingenuity of the individual constructor may determine suitable alternative means that will perform as well, if not, perhaps, with the same degree of eye appeal.

Although the retractable handset cable is not provided with a shield for the microphone line, the input impedance is sufficiently low so that elementary filtering is sufficient to prevent stray RF energy coupling back into the modulator. Although we chose to use both an RFC and bypassing, it is quite likely that a single bypass capacitor at the base of Tr5 will suffice, together with the .01uF capacitor mounted directly across the insert inside the handset.

In the receiver we have specified a number of 1/8W resistors, purely from the physical size aspect. We were able to use the more common ¼W types in our prototype but it was considered somewhat of a squeeze and we decided therefore to specify the now fairly readily available 1/8W types where necessary.

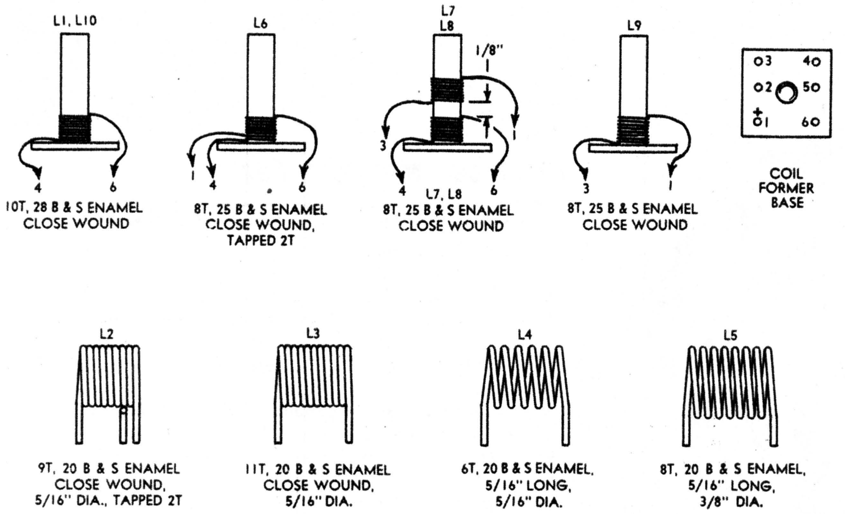
Although the use of a 10.7MHz ceramic filter appeared at first to be a fairly straightforward proposition, some difficulties did crop up. The input and output impedances of this particular filter are specified as 330 ohms which is somewhat on the low side. even for transistor circuitry. Ideally, a matching transformer should be employed apparently to effect this impedance match but this defeats somewhat the whole purpose of using such a filter in the first place.

We tried initially using an input impedance of 330 ohms but found that the 2N5485 mixer did not take kindly to looking into such a low value of drain load, the conversion gain being very low.

Accordingly, we raised the input and output impedances to around the 3K mark and found very little change in the performance of the filter although the mixer stage now evidenced a satisfactory degree of conversion gain.

A second problem which only came to light on consultation with the local suppliers concerned the wide spread in design centre frequency. While nominally specified as having a centre frequency of 10.7MHz + 35KHz, in fact the centre frequency may be anything from 10.6MHz to 10.8MHz.

Apparently this is a manufacturing problem and the makers have marked



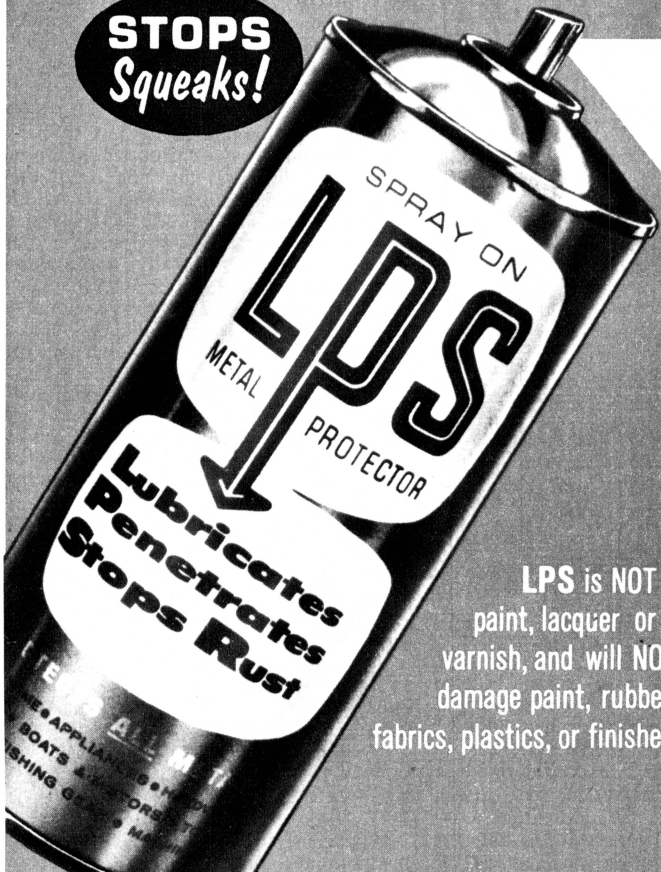
Coil dimensions should be adhered to carefully, although minor changes in wire gauge are permissible. All the coils wound on 5mm formers should be sealed with coil dope or clear nail polish after winding. Observe carefully the base pin connections.

STOP RUST OUTDOORS 2 YEARS--OR MORE!

Lubricates Penetrates Stops Rust

DRY YOUR ELECTRICAL SYSTEMS
with LPS — the NON-GREASY ONE

STOPS *Squeaks!*



LPS is NOT a paint, lacquer or a varnish, and will NOT damage paint, rubber, fabrics, plastics, or finishes.

Displaces Moisture Fast!

TECHNICAL INFORMATION

Physical Properties:
LPS 1
Less than .0001 inch non-greasy molecular film with capillary action that spreads evenly and easily to seal out moisture at very low cost.
Rust Inhibitor: Protects **all** metals from rust and corosion.
Water Displacing Compound: Dries out mechanical and electrical systems fast.
Lubricant: Lubricates even the most delicate mechanisms; non-gummy, non-sticky; does not pick up dust or dirt.
Penetrant: Penetrates to loosen frozen parts in seconds.
Volume Resistivity per ASTM D-257; Room temperature, ohm/cm; 1.04 x 10^{12}
Dielectric Constant per ASTM-877:
Dielectric Constant 2.1·1 Dissipation Factor: 0.02
Dielectric Strength per ASTM D-150:
Breakdown Voltage 0.1 inch gap.32,000 volts
Dielectric Strength volts/inch 320,000 volts
Flash Point (Dried Film)
Fire Point (Dried Film) 900 degrees F
TESTS AND RESULTS: 950 degrees F
Lawrence Hydrogen Embrittlement Test for Safety on High Tensile Strength Steels: Passed. Certified safe within limits of Douglas Service Bulletin 13-1 and Boeing D6 17487.
Mil Spec. C-16173D-Grade 3 Passed
Mil Spec. C-23411 Passed
Swiss Federal Government Testing Authority for Industry: Passed 7 Day Rust Test for acid and salt water. Passed Weiland Machine Test for Lubricity as being superior to mineral oil plus additives.

LPS PRODUCTS CONFORM TO FEDERAL MIL SPECS C-23411 and/or C-16173D

HOW LPS SAVES YOU TIME AND MONEY

1. LPS PROTECTS all metals from Rust & Corrosion.
2. LPS PENETRATES existing rust — stops it from spreading.
3. LPS DISPLACES moisture on metal—forms fine protective film
4. LPS LUBRICATES even the most delicate mechanisms at extreme temperatures.
5. LPS PENETRATES to free rust frozen parts, nuts, bolts, etc.
6. LPS PREVENTS equipment failures due to moisture (drives it out).
7. LPS LENGTHENS LIFE of electrical & electronic equipment—improves performance.
8. LPS RESTORES equipment damaged by water contamination & corrosion.
9. LPS PENETRATES AND PROTECTS plated and painted metal surfaces.
10. LPS PROTECTS metals from salt atmosphere, acid & caustic vapours.
11. LPS LOOSENS dirt, scale, minor rust spots & cleans metal surfaces.
12. LPS ELIMINATES squeaks where most everything else fails,

LPS

LPS RESEARCH LABORATORIES, INC.
2050 COTNER AVE. • LOS ANGELES, CALIF. 90025

(SOLE AGENT)

MACRON ELECTRONICS PTY. LTD.
70 BATESFORD ROAD, CHADSTONE, VICTORIA—PHONE 56-7231
MANUFACTURERS OF RADIO & ELECTRICAL EQUIPMENT & COMPONENTS

their filters with a colour code indicating the actual centre frequency obtained within the range mentioned. This in itself would not pose any real difficulty were it not that the manufacturer does not undertake to supply a specific centre frequency to order. Rather, it appears one must take "pot luck" with what is supplied, although he will be aware of the frequency, after he gets his filters, by reference to the code colour.

Having gone to the trouble to ascertain the centre frequency and mark it accordingly we would have considered it logical to market the filters separately under their individually specified centre frequencies but apparently this is not the case.

It appears necessary, therefore, to know specifically what the first intermediate frequency is going to be before one orders the HF oscillator crystal, assuming a specific net frequency is required. Fortunately, this is not strictly necessary, as the particular HF oscillator circuit used in the receiver permits the crystal frequency to be pulled by an amount which should absorb the error introduced by even the furthest out filter likely to be encountered.

We would suggest that the first IF be considered as a nominal 10.7MHz, the HF crystal ordered accordingly and any corrections made during the alignment process to be described later.

As far as the construction is concerned there are several points worth mentioning. We would suggest as an initial step that all the coils be wound for both receiver and transmitter, together with the ferrite RF chokes. These items, together with the shield can, where applicable, should be mounted on the P/C board before the smaller components are fitted.

Incidentally, the 680-ohm resistor shunted across L9 can be mounted inside the can if a 1/8W unit is used as specified. Otherwise it will have to be soldered across the appropriate coil pins beneath the board.

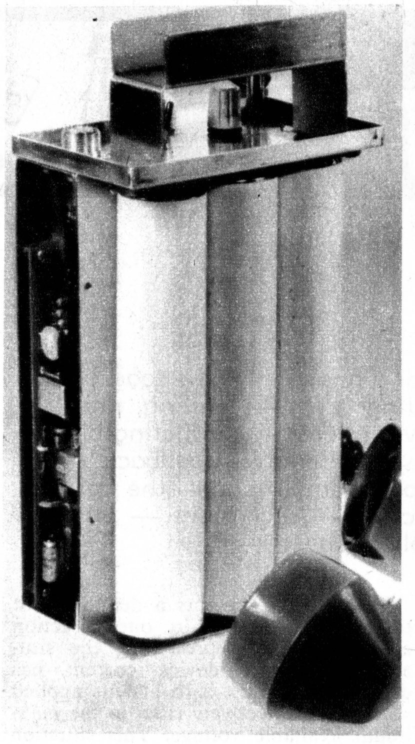
If a printed circuit edge connector is to be used, it will be necessary to cut carefully the polarising keyway in the P/C board, shown dotted in the copper laminate to one side of the connector contact strips. This is best done with a hacksaw blade and finished with a small flat file.

All the resistors and capacitors may be mounted next. We would stress the importance of following the layout as indicated in the diagrams, particularly in relation to those resistors mounted vertically. The polarity of both electrolytic and tantalum capacitors should also be observed. High leakage currents can flow if these are incorrectly connected into the circuit.

It may be observed during assembly that one or two holes in the printed board do not apparently have any components attached. In planning ahead we have made provision for some modifications which will be described at a later date when these holes will be utilised.

As the cases of Tr11 and Tr12 are tied to earth and the 12V supply line respectively, ensure that the leads from other components are kept clear.

It will be noted from the photographs that we have used heat sinks on both PA and modulator transistors. They may be omitted from the modulator transistors unless prolonged operation under sinewave conditions is



The batteries are shown fitted into their retainer tubes in the above photo. The aluminium panel between the batteries and the transceiver compartment carries the bottom battery contact spring in the centre of its lower edge.

anticipated. They have not been specified in the parts list.

As noted earlier, the PA transistor and some used in the modulator have the collector lead tied to the case. If a different heat sink is used to the type shown in the photo, care must be taken to ensure that it does not come into contact with any other components. A heat sink possessing integral radiating fins is preferred to one merely providing an attachment to a chassis surface.

The transistors, diodes, relay and modulation transformer should be left until last. The transformer is mounted on the board using tapped brass spacers instead of nuts, the idea being that the weight of the transformer is taken by the base plate and not the P/C board. If insufficient clearance is obtained between the top of the modulation transformer and the battery compartment, the transformer may be lowered by removal of the crimped lugs holding the core stack.

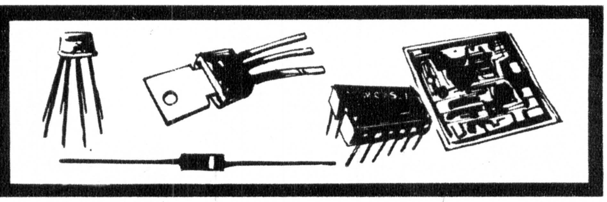
THIS MAY BE A DESIRABLE MODIFICATION IN ANY CASE, AS IT RESULTS IN LESS DEFORMATION OF THE BOARD WHEN THE MOUNTING SCREWS ARE TIGHTENED DOWN.

Connections from the relay to the transmitter output, receiver input and audio input circuits are made beneath the board, using small diameter coaxial cable. The connection from the relay to the aerial socket is by a short length of heavy tinned copper wire.

The aerial socket, call switch, squelch and volume control poten-

(Continued on page 189)

Fundamentals of SOLID STATE



Chapter 12

by Jamieson Rowe

Linear operation and the bipolar transistor — the load line and choice of quiescent operating point — biasing, parameter spread and temperature variations — conflicting bias supply requirements — the use of negative feedback — practical biasing circuits — bipolar amplifiers — the basic configurations — practical circuits — oscillators — other bipolar applications.

Having examined, in the two preceding chapters, both the basic theory of operation and the important practical characteristics and ratings of the bipolar transistor, the reader should now be in a position to consider the application of this device to typical circuitry. Accordingly, the present chapter and that which follows will discuss device applications. This chapter will examine the application of bipolar devices in so-called "linear" circuitry, while chapter 13 will deal with circuit applications in which they are used as switching elements.

Broadly speaking, "linear" circuits are circuits whose operation involves relatively smooth and continuous changes in voltage and current levels, and in which the active devices present are usually required to produce an "output" signal varying proportionally to the "input" signal over at least a significant part of the signal cycle. To satisfy this requirement it is generally necessary to arrange that the active devices are biased at a quiescent operating point which ensures that the device parameters remain as constant as possible over at least part of the range of circuit conditions involved.

Naturally enough, the exact position selected on the characteristic of each active device for the quiescent operating point will depend to a certain extent upon the requirements of each particular application. However in many cases the prime requirement is for the device parameters to remain constant for the largest possible output voltage and current signal excursions. This applies equally whether the active devices concerned are bipolar transistors, FETs or thermionic valves.

With bipolar devices this broad requirement is often satisfied by placing the quiescent operating point at a position similar to that marked "Q" in the diagram of figure 12.1 Here the family of curves shown are those of the common-emitter characteristics of a device, while the oblique line PQR is a **load line** representing the effect of the collector load resistance (or impedance) on the collector-emitter voltage.

The load line represents the locus of available operating points for the transistor, in terms of Vc and Ic. In operation, the device effectively slides up and down this line.

Point "P" represents a definite limit to linear operation in one direction along this line, representing the situation where the device current has dropped to almost zero and its applied voltage has effectively risen to the maximum available voltage. This situation is normally referred to as **cut-off.**

Similarly point "R" represents the limit of linear operation in the other direction along the load line, as this represents the situation where the device is **saturated** or "bottomed." It is drawing maximum current Ic(sat), while its applied voltage has fallen to the low saturation value.

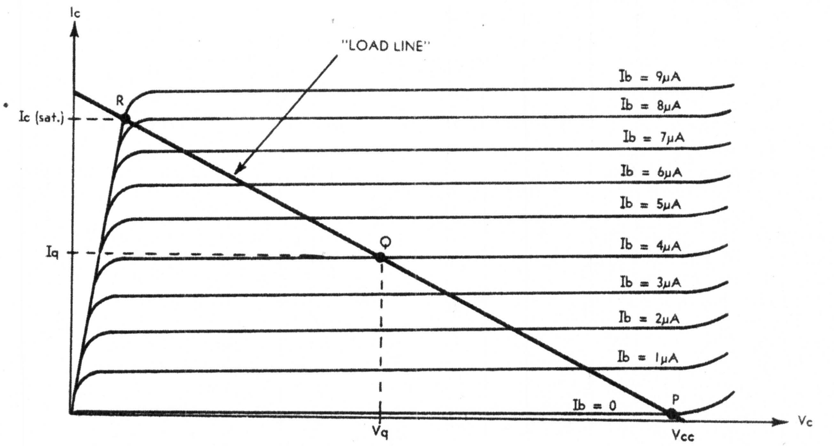


Figure 12.1

It is over the portion of the load line between cut-off and saturation that the parameters of most devices are relatively constant. Hence in a situation such as that in figure 12.1 it is the portion of the load line beween P and R which corresponds, at least nominally, to "linear" operation. With most devices the essential parameters vary only slightly over this portion of the load line, due to beta variation and other second-order effects.

Just where the quiescent operating point is placed on the linear portion of a load line depends upon the type of circuit involved, and upon the collector signal waveforms which must be handled. However, in a majority of amplifier and oscillator applications, the collector signal waveform involves fairly symmetrical excursions of both polarities about the operating point, and the usual design aim is to permit the device to operate linearly for the largest possible peak-to-peak collector voltage and current swings.

Placing the quiescent operating point Q at a position midway along the linear portion of the load line satisfies this requirement, as may be seen from figure 12.1. At this point the device is drawing a current Iq approximately equal to half Ic(sat), and its applied voltage Vq is approximately equal to half the available maximum voltage. With a resistive collector load the available maximum peak-to-peak voltage will approach the supply voltage Vcc, as shown, while with reactive load or a load reflected via a transformer it will be nearer twice this value.

Basically a bipolar transistor is placed at the desired quiescent operating point by the application of the appropriate forward bias to the base-emitter junction. Thus for the device whose characteristics are shown in figure 12.1, a bias which produced a base current Ib of approximately 4uA would be applied in order to set the operating point at Q.

While seemingly a simple matter, biasing of bipolar transistors is in practice complicated by a number of factors. One of these is that, like FETs, bipolar transistors are subject to appreciable parameter spreads. The common-emitter current gain beta is typically subject to a spread of about 3:1, for example, and this alone complicates biasing significantly.

As with FETs, the parameter spread causes each individual device of a particular transistor type to have its own unique family of Vc/Ic curves. Thus a device type cannot be represented simply by a single family of characteristic curves as shown in figure 12.1, but

could really only be represented by a whole "family of curve families."

Because of this, if one simply designs the biasing circuit of a transistor stage to supply the device with a fixed base current, the resulting operating point will depend very much on the gain of the particular device concerned. Only with a nominal or "bogie" device will it be near the optimum point, while with very high or very low gain devices it may be well away from this position.

Quite apart from parameter spread, there is a second major factor which complicates bipolar transistor bias design. This is that many of the key device parameters determining the operating point of a bipolar device are significantly **temperature dependent.**

Beta itself is temperature dependent to a moderate degree, usually tending to rise slowly with temperature. However, this is a second-order effect, and usually of far less practical significance than the temperature dependence both of **Icbo,** the reverse bias saturation and leakage current of the collector-base junction, and of **Vbe,** the forward voltage drop of the base-emitter junction.

Being composed largely of minority carriers generated by the "intrinsic" mechanism, Icbo tends to rise rapidly and exponentially with temperature. For germanium transistors it approximately doubles in magnitude for every 8-10 deg.C rise, while for silicon devices it approximately doubles for every 5 deg.C rise.

As we have seen in an earlier chapter, Icbo tends to provide the base of the device with excess majority carriers, which in turn attract opposite polarity carriers from the emitter and so initiate device operation. In other words, Icbo tends to provide an effective "internal" forward bias component, acting additionally to any bias which may be applied to the device externally.

This means that because Icbo is strongly temperature dependent, there is a corresponding tendency for the effective bias on a bipolar transistor to rise with temperature, and the operating point to move accordingly. This is particularly true for germanium devices, where Icbo typically has a value at 25 deg.C of a few microamps. The effect is generally somewhat less evident with silicon devices, despite the higher temperature coefficient involved, because with these devices Icbo is typically some three orders of magnitude lower — only a few nanoamps at 25 deg.C. The relative magnitudes and temperature coefficients of Icbo for silicon and germanium devices are illustrated in the diagram of figure 12.2.

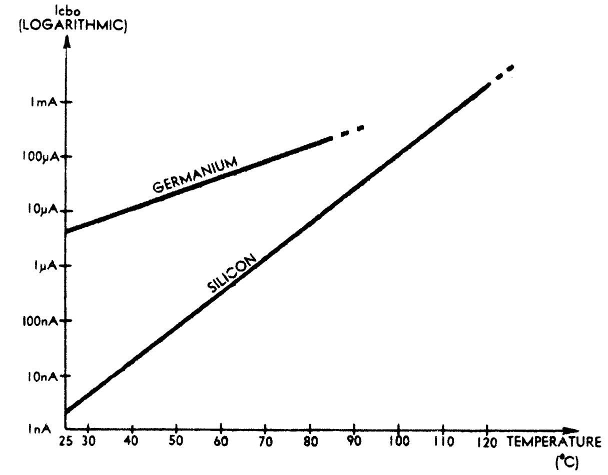


Figure 12.2

It is true that the extent to which Icbo does in fact supplement any external bias depends, as we have seen, upon the effective resistance connected externally between base and emitter. The lower this resistance, the greater the proportion of Icbo shunted around the base-emitter junction, and the smaller the influence of Icbo upon device operation. In order to reduce the effect of Icbo and its temparature dependence upon device biasing, one must therefore generally arrange the bias circuit connected between base and emitter to present the lowest practical source resistance.

The base-emitter forward voltage drop Vbe is also temperature dependent, being in this respect no different from any other forward biased P-N junction. However, in contrast with Icbo, the temperature coefficient is in this case negative, corresponding to the reduction in junction barrier potential as the Fermi levels in the P-type and N-type materials approach each other with increasing "intrinsic" carrier generation. With both germanium and silicon devices Vbe tends to decrease by approximately 2.5mV/deg.C, as shown by the typical curves of figure 12.3.

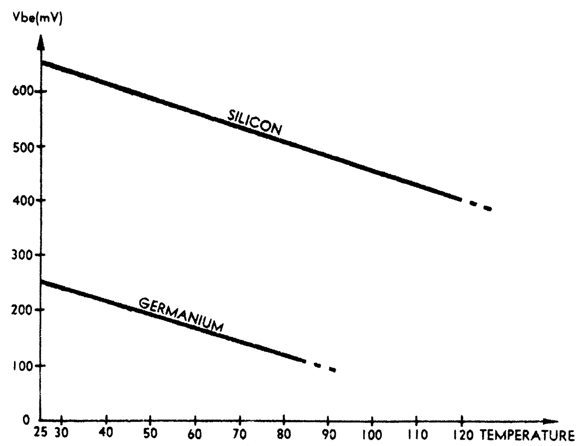


Figure 12.3

The negative temperature coefficient of Vbe tends to produce exactly the same type of change in operating conditions as the positive temperature coefficient of Icbo: a rise in base current Ib with temperature, and a corresponding change in quiescent current. And, unfortunately, the very same reduction in bias circuit source resistance which is desirable in order to reduce the effect of Icbo tends to accentuate the effect to Vbe. The lower the bias circuit source resistance the closer the bias supply approaches the "constant voltage" situation, in which Vbe has maximum influence on Ib.

The effect of Vbe is actually inversely proportional to the bias circuit source resistance, and would fall to zero in the extreme case where the source resistance was increased to produce the "constant current" situation. Hence as far as bias circuit source resistance is concerned, there is a direct conflict between the requirements for reducing the effects of Icbo and Vbe.

Luckily, there are other means available for reduction of the effects of both Icbo and Vbe, so that this conflict does not lead to insoluble biasing problems. In general, practical biasing methods involve either supplementing the adjustment of the bias circuit resistance by the addition of negative feedback, or else adoption of the approach of deliberate temperature compensation, as will be shown in a moment.

In passing, it may be noted that because of the common tendency of Icbo and Vbe to cause device currents to increase with temperature, and the fact that there is a conflict between the biasing requirements for minimising the effect of these parameters, the bipolar transistor may be regarded as having an inherent tendency toward thermal instability or **thermal runaway.** The current tends to increase with temperature, and as an increase in current often tends to increase power dissipation and accordingly increase temperature, there is a definite positive feedback effect.

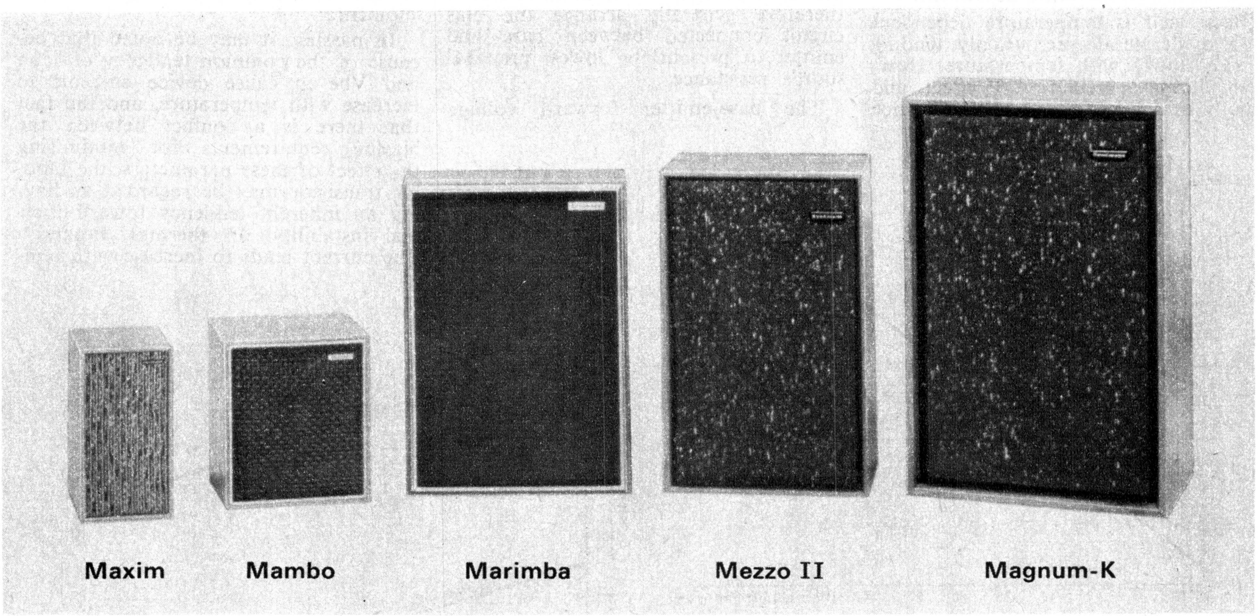
Unless the circuit is designed to stabilise device operation by reducing this positive feedback effect to a very low level, a bipolar transistor may either destroy itself, or at the very least cause its own operating point to slide up to the high-current "saturation" extreme of the load line.

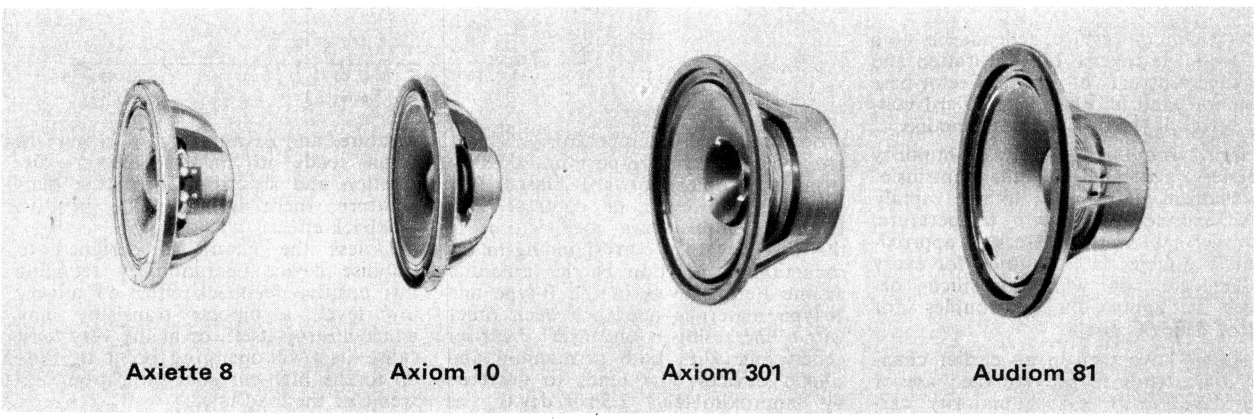
The positive feedback and tendency toward thermal instability of the bipolar transistor are in sharp contrast with the behaviour of FET devices. Not only does the actual operation of the latter devices provide an inherent negative feedback mechanism which tends to stabilise the operating point, but also the temperature coefficients of the primary device parameters are such that they tend to cause FET devices to protect themselves by moving their operating point slowly towards cut-off as the temperature rises.

Some of the more commonly used bipolar transistor biasing circuits are shown in figure 12.4. These may be used to illustrate the basic concepts introduced in the foregoing.

The simplest method of bipolar tran-

Goodmans
The Greatest Name–
The Greatest Range in
High Fidelity





Forty years of experience in the Audio Industry are at your service at **Goodmans.**

Whether you prefer to build your own loudspeaker enclosure, to have it made for you, or whether you want a loudspeaker system complete – **Goodmans** is the name to look for.

High Fidelity Loudspeakers from 8″ to 15″, Treble and Mid–range units, crossovers and other components to go with them on the one hand, or complete systems from the famous mini **Maxim** to the studio – quality 25 watts **Magnum–K** on the other.

See what a choice is yours – send for your free copy of the 28 page Goodmans High Fidelity Manual which comes complete with cabinet drawings and interesting articles about Stereo and High Fidelity, and includes full details on Goodmans High Fidelity Amplifiers and Radio Tuners – or call in at your Goodmans dealer.

Please send me a free copy of the Goodmans High Fidelity Manual

Name ....

Address ....

....

Sole Aust. Agent: **British Merchandising Pty. Ltd.,** 49-51 York St., Sydney. Phone 29-1571

sistor biasing is known as **current biasing** or "fixed biasing," and is shown in figure 12.4(a). As may be seen, it involves a single resistor Rb which is usually connected between the base electrode and the collector supply rail. The value of Rb is arranged to produce the required base current Ib, using Ohm's law: Ib = (Vcc − Vbe)/Rb.

If the supply voltage is greater than about 6V, the effect of Vbe in determining the bias current becomes insignificant, as Vbe is only about 0.65V for silicon transistors and about half this value for germanium devices. This is true in most applications, so that typically Ib is effectively determined only by Vcc and Rb, and is independent of the device itself; hence the description "fixed biasing."

The operating point stability provided by this type of biasing circuit is rather poor. The effects of Vbe and its negative temperature coefficient are reduced to a negligibly low level by the effectively fixed bias current Ib, to be sure, but on the other hand Icbo and its positive temperature coefficient generally assume maximum significance, due to the very high resistance of the bias source. The fixed bias current also tends to make the operating point significantly dependent upon beta, both in terms of spread variation and also in terms of temperature coefficient.

It is almost impossible to obtain adequate operating point stability using current bias with germanium transistors, due to the relatively high Icbo of these devices. Because of this, it is almost never used for such devices. The few exceptions are generally low power stages in very low cost equipment, intended for uncritical use within a restricted temperature range.

The very much lower Icbo levels of modern silicon transistors allow current biasing to be used to a somewhat greater extent, it is true, as with these devices the effect of Icbo is generally negligible at typical operating temperatures even with quite high bias circuit source resistance. However, the somewhat wide beta spread range of these devices still tends to restrict the use of current biasing to low cost applications, or to applications where either the bias resistors or the devices may be individually selected.

Some small improvement in operating point stability over that provided by current biasing may be obtained by feeding the base of the device from a resistive voltage divider, as illustrated in figure 12.4(b). Here the effective bias source resistance is equal to the parallel combination of Ra and Rb, and may thus be made very much lower than in the fixed bias case. The appropriate forward bias is applied to the device by manipulation of both the actual values of the resistors, and their ratio.

Because it provides a closer approach to a "constant voltage" bias source, **voltage divider biasing** generally allows the effects of Icbo to be made negligible. It also tends to stabilise the operating point against spread and temperature variations in beta.

It may be remembered from the preceding chapter (expression 11.5) that the input resistance of a device in the common-emitter configuration is directly proportional to beta. Because of this, changes in beta tend to cause a corresponding change in input resistance, which interacts with the essentially constant bias voltage provided by the bias divider to produce an opposite and compensating change in the input current Ib. Hence when beta is high, Ib tends to be low, and vice-versa.

Unfortunately while voltage-divider biasing does reduce the effects of Icbo and beta variation, it does not generally allow satisfactory stabilisation against Vbe variations. In fact, the lower is made the bias source resistance in order to stabilise against Icbo and beta variations, the more significant does Vbe become in comparison with the effective bias source voltage, and the greater the effect of Vbe variations. This illustrates the conflicting requirements for bias supply source resistance, noted earlier.

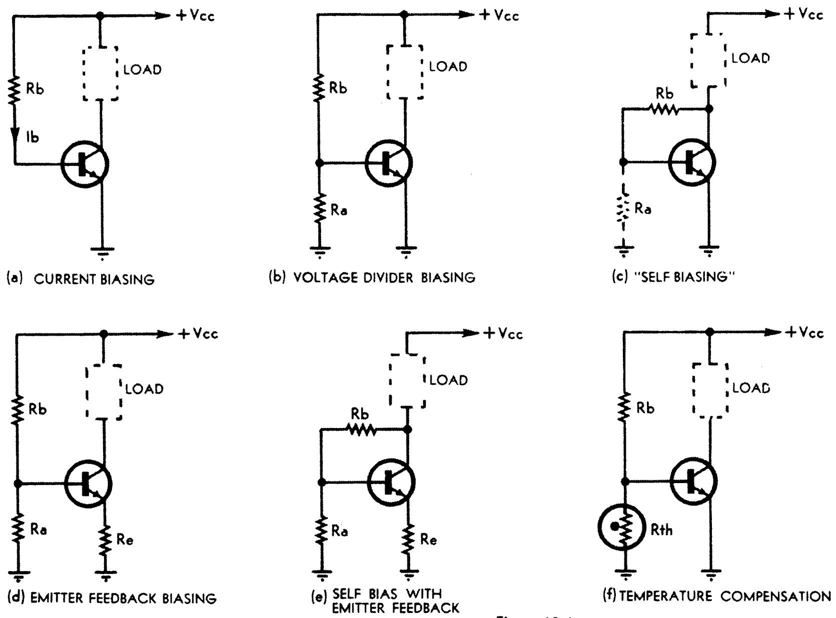


Figure 12.4

In some applications voltage divider biasing has the further disadvantage that, in order to achieve sufficiently low values of bias source resistance, the values of the divider resistors must be reduced to the point where the standing current drawn by the divider itself becomes comparable with, or can even exceed, the quiescent current of the transistor. In low-consumption battery equipment this can be very embarrassing where many stages are involved.

As mentioned earlier, negative feedback techniques may be used to overcome the conflict in bias source resistance requirements. One such method involves connection of the bias resistor Rb not to the collector supply rail Vcc, but direct to the collector of the device itself. This is illustrated in figure 12.4 (c), being known as **self biasing.**

Because of the finite resistance of the load in the collector circuit, the actual collector voltage of the device normally tends to vary inversely with collector current. By taking Rb, suitably modified in value, back to the collector, this voltage change can be used to automatically vary the bias in a direction which tends to counteract any change in collector current due to Icbo, Vbe or beta variations.

The basic self-biasing technique may be used with either single resistor current biasing or voltage divider biasing, as shown. The current biasing variant usually provides satisfactory stabilisation with silicon transistors, particularly in low power circuitry in which the collector load is a resistor. However the voltage divider variant is preferable, especially for germanium devices, because the lower bias source resistance tends to reduce the effects of Icbo and beta variations, leaving only Vbe variations to be compensated by the negative feedback.

It should be noted with regard to self-biasing that the resistor Rb connected between base and emitter tends to produce negative feedback for "wanted" signal variations just as much as for unwanted changes in the quiescent operating point. As a result the effective gain of a device may be significantly lowered in cases where the input signal fed to the device comes from a relatively high impedance source. To prevent this effect, Rb is often split into two series components, and the junction of the two bypassed either to ground or to the emitter by means of a suitably high-value capacitor.

A second negative feedback biasing technique, quite distinct from self-biasing, involves an additional resistor Re connected in series with the emitter electrode. This is the **emitter feedback** technique, illustrated in figure 12.4(d).

Here the basic idea is that Re develops a voltage drop due to the emitter current Ie, and this voltage forms an effective component of base-emitter bias whose polarity is opposite to the forward bias applied to the base. The base voltage divider is arranged to provide a higher forward bias than in the case of 12.4(b), to compensate for this "bucking" component and produce the desired nominal emitter and collector currents. However in operation any tendency for Ie to change causes the voltage drop across Re to change accordingly, and this results in an automatic change in the effective base-emitter bias in the direction to counteract the tendency.

It may be seen that the negative feedback effect of Re is basically very similar to that associated with the "cathode bias" resistor of a thermionic valve, or the "self-bias" source resistor of JFETs and types A and B MOSFETs. However the action is not exactly the same, because whereas the thermionic valve and the field effect devices just mentioned are "normally on" devices, for which biasing may often consist solely of self-regulating negative feedback, the bipolar transistor is in contrast a "normally off" device. Like the type C JFET, it must therefore always be provided with some effective forward bias, to which may be added negative feedback components for the purpose of stabilisation.

As one might expect, the effectiveness of the negative feedback provided by the emitter resistor in stabilising the quiescent operating point is almost directly proportional to the ratio between the emitter resistor voltage drop and the resultant or effective base-emitter bias. If the feedback component is large compared with the resultant bias, the feedback will be very effective; but naturally if the feedback component is relatively small compared with the resultant bias, it will only be partially effective in counteracting current changes.

Generally the feedback component cannot itself be made very large, because the voltage drop across Re tends to reduce the available collector supply voltage and hence restrict the possible output voltage swing. To obtain effective feedback action, the forward bias applied to the base must therefore also be kept relatively low — or in other words, the base must be fed from a "voltage source" rather than a "current source." This implies either voltage divider biasing, as shown, or biasing from some other effective source of low voltage; current biasing cannot be used as this would tend to defeat the negative feedback action.

Note that the foregoing reasoning is actually identical with that given previously, in explaining why simple voltage divider biasing not only provides no control over Vbe variations, but in fact accentuates the effect of such variations. The only difference is that in the earlier case we were seeking to reduce the influence of Vbe, whereas in the present case we have been seeking to allow the negative feedback bias component to exercise the maximum stabilisation.

It is often found worthwhile to visualise the operation of emitter feedback biasing in terms of the effect of resistor Re upon the effective input resistance of the transistor as seen by the base bias source. Because of the amplification action of the device, Re will be seen by the base bias source as a resistor of value beta times its actual value, connected in series with the base-emitter junction. This very high effective resistance thus tends to produce pseudo-constant current biasing, by virtually "swamping" any tendency for Vbe to influence the base current Ib.

Because the action of the emitter feedback resistor may be visualised in this way it is often known as the "emitter swamping resistor."

Like bias resistor Rb in the self-biasing circuit, the emitter feedback resistor Re tends to introduce negative feedback for wanted signals just as much as for unwanted changes in the quiescent operating point. And as before, this can significantly lower the effective gain of the device. In this case the effect is not determined by the signal source impedance, however, but by the effective collector loading impedance.

The effective voltage gain in fact becomes stabilised by the negative feedback action, along with the quiescent operating point, becoming almost exactly equal to the ratio between the collector load and Re. Hence the larger Re is made relative to the load, the lower the effective voltage gain. In some applications this effect is deliberately used either to reduce the gain, or to stabilise the gain against parameter spread variations.

In other applications, of course, the gain reduction effect can be quite a nuisance, it being desirable to obtain full gain from the device. Happily this may be arranged simply by providing Re with effective signal bypassing, via a suitably high-value capacitor.

The emitter feedback biasing circuit shown in figure 12.4(d) is capable of providing very stable operation with both silicon and germanium transistors, as it may be designed to compensate almost completely for variations in all three parameters Icbo, Vbe and beta. For this reason it is the biasing circuit most commonly used for low and medium-power transistor circuitry.

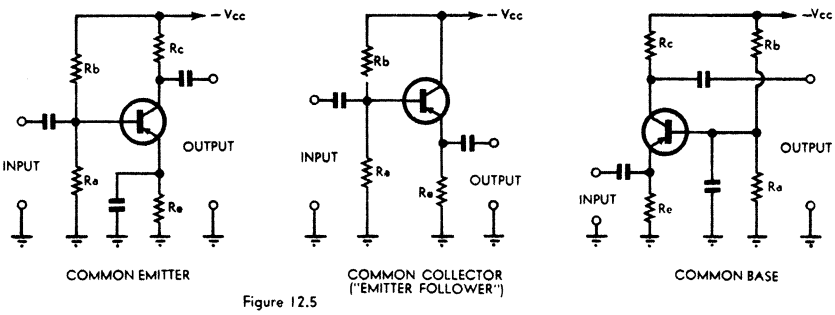


Figure 12.5

There are cases, however, in which emitter feedback biasing alone cannot provide the desired order of operating point stability, due either to the need to stabilise over a very wide temperature range, or to the need to make compromises in setting the values of Re and/or the bias divider resistors. In such cases it is often found worthwhile to combine the self-bias and emitter feedback techniques, as shown in figure 12.4(e). By utilising two distinct sources of negative feedback, this combination circuit is generally capable of providing excellent stabilisation.

In many transistor circuits operating at high power levels the emitter feedback biasing method cannot be used, because an emitter resistor would reduce significantly the power fed to the load. This is often unfortunate, as such circuits usually operate at elevated temperatures where a high degree of stabilisation is desirable in order to guard against thermal runaway.

As self-biasing may not always be possible in such applications due to the type of load involved, while simple voltage divider biasing may not provide adequate stabilisation, some other means of maintaining the operating point must generally be found. Often this takes the form of a negative feedback system which monitors the temperature of the transistor, rather than its current.

Generally this approach involves the use of a device having a negative temperature coefficient, connected into the lower arm of the base bias divider, and placed in thermal contact with the transistor case. Thus, as the transistor temperature rises, the bias is automatically reduced. The temperature sensing element may be either a thermistor, as shown in figure 12.4(f), or a combination of one or more forward-biased P-N diodes. A thermistor is usually used with germanium devices, while diodes are usually used with silicon devices.

It may be noted that the biasing methods which have been discussed in the foregoing are all associated with a single transistor device, i.e., they are single-stage biasing circuits. As the reader might well have predicted, these are not the only possible biasing methods, for when devices are used in combination it becomes possible to arrange more complex biasing circuits involving direct coupling between a number of devices.

There are a great many variations possible with such multi-stage biasing methods, in some cases exploiting either the compensating temperature variations in complementary NPN and PNP devices, or the stabilisation action provided by negative feedback around many high gain devices connected in cascade. Unfortunately space limitations do not permit further discussion of such methods in the present treatment, and interested readers must be referred to the references given at the end of this chapter.

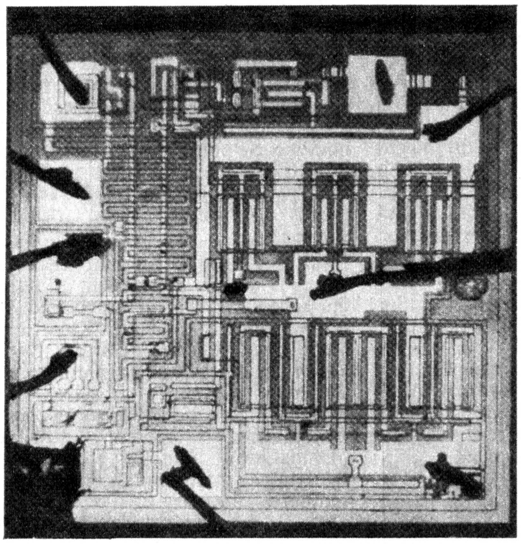
A final note which should perhaps be made before leaving the topic of bias stabilisation is that while the diagrams shown in figure 12.4 show NPN devices, this should by no means be taken to imply that any of the biasing methods described applies only to these devices. All methods apply equally to PNP devices, for which the supply polarity is simply reversed.

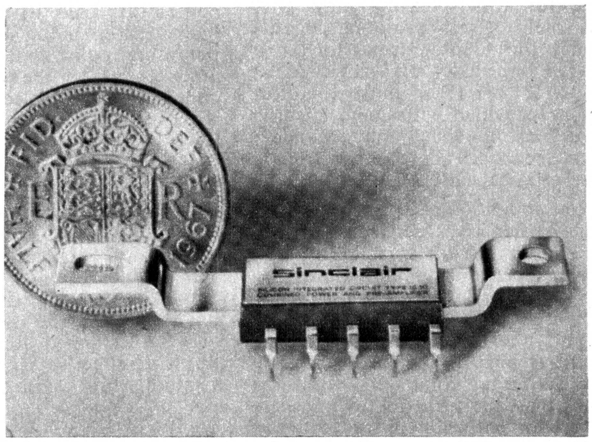
Having looked at the basic techniques used to bias bipolar transistors at a quiescent operating point appropriate for "linear" operation, let us now turn to examine briefly some of the very many applications of these devices in linear circuitry.

As with both field-effect devices and thermionic valves, probably the most common application of bipolar transistors is in amplifier circuits. The use of bipolar transistors in amplifier applications in fact far exceeds the use of FET devices at the time of writing, and has possibly now also exceeded that of

SINCLAIR IC-10

MONOLITHIC INTEGRATED CIRCUIT AMPLIFIER AND PRE-AMP





the world's most advanced high fidelity amplifier

The Sinclair IC-10 is the world's first monolithic integrated circuit high fidelity power amplifier and pre-amplifier. The circuit itself, a chip of silicon only a twentieth of an inch square by one-hundredth of an inch thick, has 5 watts R.M.S. output (10w. peak). It contains 13 transistors (including two power types), 2 diodes, 1 zener diode and 18 resistors, formed simultaneously in the silicon by a series of diffusions. The chip is encapsulated in a solid plastic package which holds the metal heat sink and connecting pins. This exciting device is not only more rugged and reliable than any previous amplifier, it also has considerable performance advantages. The most important are complete freedom from thermal runaway due to the close thermal coupling between the output transistors and the bias diodes and very low level of distortion.

The IC-10 is primarily intended as a full performance high fidelity power and pre-amplifier, for which application it only requires the addition of the usual tone and volume controls and a battery or mains power supply. However, it is so designed that it may be used simply in many other applications including car radios, electronic organs, servo amplifiers (it is d.c. coupled throughout), etc.

● SPECIFICATIONS

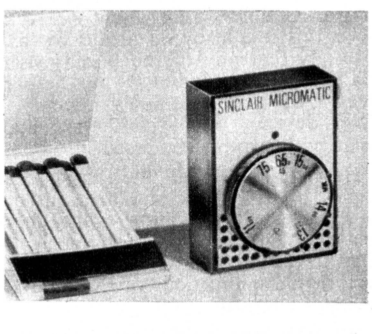
Output: 10 Watts peak, 5 Watts R.M.S. continuous.
Frequency response: 5 Hz to 100 KHz ± 1 dB.
Total harmonic distortion: Less than 1% at full output.
Load impedance: 3 to 15 ohms.
Power gain: 110dB (100,000,000,000 times) total.
Supply voltage: 8 to 18 volts.
Size: 1 x 0.4 x 0.2 inches.
Sensitivity: 5mV.
Input impedance: Adjustable externally up to 2.5 M ohms.

● CIRCUIT DESCRIPTION

The first three transistors are used in the pre-amp and the remaining 10 in the power amplifier. Class AB output is used with closely controlled quiescent current which is independent of temperature. Generous negative feedback is used round both sections and the amplifier is completely free from crossover distortion at all supply voltages, making battery operation eminently satisfactory.

● APPLICATIONS

Each IC-10 is sold with a very comprehensive manual giving circuit and wiring diagrams for a large number of applications in addition to high fidelity. These include stabilised power supplies, oscillators, etc. The pre-amp section can be used as an R.F. or I.F. amplifier without any additional transistors.



MICROMATIC
WORLD'S SMALLEST RADIO
Technical specification
Size: 1 13-16 in x 1 7-16in x ½in (46 x 33 x 13mm).
Weight including batteries: 1oz (28.35 gms) approx.
Transistors: High gain silicon types.
Circuit: Five stage reflex.
Aerial: Self-contained ferrite rod.
Earpiece: High-fidelity magnetic type for best possible quality.
Battery requirements: Two Mallory Mercury Cells, type RM 675, giving extra long working life.
Complete Kit with Instructions.
$7 plus sales tax.

SINCLAIR IC-10

Price including Instruction Manual $10.00 plus sales tax

Sinclair PZ.4 Stabilized Mains Power Supply Unit

Ready Built $13.60 plus Sales Tax.

This is a power supply unit of advanced design in which four transistors are used in an arrangement to ensure the stabilized output desirable to achieve best possible results when used with one or two IC10's.
Output—17.5V D.C. at 1.5 A. Ripple less than 20mV. For A.C. mains operation 210/240V.
Size—4¼" x 3" x 2¼".

CENTRAL IMPORTS PTY. LTD.

196 ADELAIDE TERRACE, PERTH, W.A.
PHONE 23-5103

All items ex stock immediate delivery

thermionic valves. This gives a good idea of the suitability of the bipolar transistor for many of these applications.

The variety of amplifier applications in which the devices are used is almost endless, including both small-signal and power amplifiers for audio, servo and other LF amplifiers, small-signal and power amplifiers for radio frequencies (RF), direct-current or DC amplifiers, operational amplifiers, wideband or "video" amplifiers, and instrumentation amplifiers. In almost every such application they may be used either alone or in conjunction with other devices such as FETs, and also either as a single type (NPN or PNP), or in mixed-type complementary circuitry.

Just as with FET devices and thermionic valves, bipolar amplifiers use only three basic device configurations. These are known respectively as the **common emitter, common collector and common base** configurations, and are illustrated in figure 12.5 as implemented for R-C coupled audio circuitry using PNP transistors.

The common emitter configuration may be seen to be the bipolar equivalent of the common cathode thermionic valve stage, and the FET common source configuration. The input signal is applied via a coupling capacitor to the base, while the output signal is taken via a similar coupling capacitor from the collector. Although the emitter feedback biasing method is shown, other methods may be used depending upon the specific application. Where an emitter resistor is used it is usually bypassed as shown, to prevent signal negative feedback.

This bipolar amplifier configuration provides a high order of voltage gain, useful power gain and a moderate input resistance. Typical stages may be arranged to give voltage gains in the order of 40-180 times, which compares very favourably with thermionic valve circuits. Current gain figures in the same order are also obtainable.

The input resistance of a common emitter amplifier stage consists of the input resistance of the device itself in parallel with the effective shunt resistance of the biasing network, as one might expect, and therefore tends to be somewhat lower than the input resistance of the device alone. The reader may recall from the preceding chapter that the input resistance of a bipolar transistor in the common emitter configuration depends upon its current gain and emitter current level, varying from a few ohms for a low gain power device operating at high current levels to many hundreds of kilohms for a high gain silicon device operating at very low current levels. Depending upon the device and the biasing circuit employed, therefore, a typical common emitter stage presents an input resistance of between a few ohms and a few hundred kilohms.

The output impedance of a common emitter stage is equal to the combination of the output resistance of the device itself in parallel with the collector load Rc. Generally the output resistance of the device is very much higher than Rc, however, so that in most cases the effective output impedance is almost exactly equal to Rc.

The common collector or "emitter follower" configuration is the bipolar equivalent of the cathode follower and source follower stages. Here the input signal is applied as before to the base by means of a suitable coupling capacitor, while the output signal is taken from the emitter. The collector is connected directly to the supply rail. The emitter resistor Re forms both the DC load resistor and the emitter feedback resistor, and as this dual function generally allows its value to be made somewhat higher than in the other configurations, the biasing stability of a common collector stage is usually excellent.

As with the corresponding thermionic valve and FET configurations, the common collector configuration provides no voltage gain but rather a slight voltage loss. However it provides a significant current gain, and also provides a very useful impedance transformation by virtue of a relatively high input resistance combined with a relatively low output impedance. Common collector stages are accordingly often used for isolation and impedance matching.

The input resistance of such a stage consists of the parallel combination of device and bias network resistances, as before, but in this case the input resistance of the device itself is much higher than in the common emitter configuration. It is in fact equal to beta times the sum of the base-emitter resistance of the device itself and the parallel combination of emitter resistor Re and the following AC load.

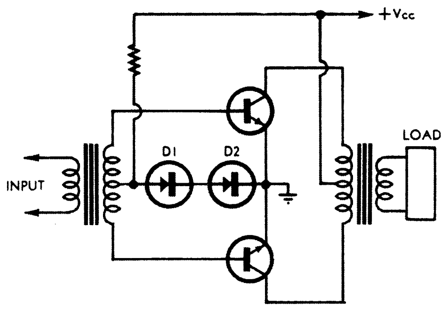
As a result of this increase in the effective input resistance of the device itself, the effective input resistance of a common collector stage is very often determined almost completely by the bias network. And because of the excellent thermal stabilisation provided by the large emitter resistor the bias network can often be arranged to present quite a high shunt resistance — as high as two or three megohms, if silicon transistors are used. Where germanium devices must be used or where even higher values of input resistance are required, it is possible to employ special techniques such as "bootstrapping" to produce effective multiplication of the bias network resistance, at signal frequencies.

The output impedance of a common collector stage is usually quite low, being equal to the output resistance of the device itself in parallel with the emitter resistor Re. The output resistance of the device is generally much lower than Re, being equal to the sum of the resistance of the base-emitter junction and a fraction $1/\beta$ of the effective resistance from base to ground provided by the bias network and signal source.

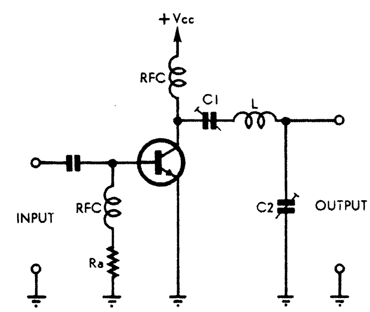
It may be seen from the foregoing that the input and output impedances of a common collector stage are not independent of each other, so that such a stage does in fact behave rather like an impedance "transformer." As such it provides less isolation between input and output circuits than either of the corresponding thermionic valve or FET configurations.

The common base configuration of a bipolar transistor corresponds broadly to the common gate FET stage, and to the "grounded grid" thermionic valve stage. It provides high voltage gain and a very slight current loss; however it also exhibits a very low input resistance, equal to the parallel combination of emitter resistor Re and the base-emitter junction resistance. These characteristics make the common base configuration of limited usefulness except at very high frequencies, where it becomes of interest because of the higher cut-off frequency associated with the common-base gain factor alpha.

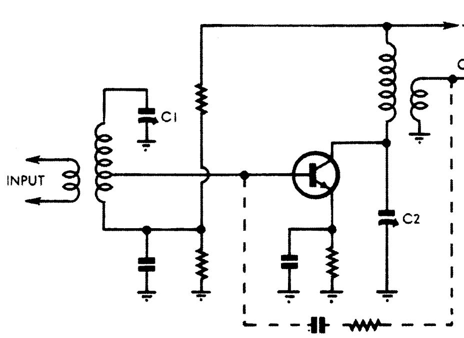
Low level bipolar amplifier circuitry designed for audio and other LF applications generally uses emitter feedback



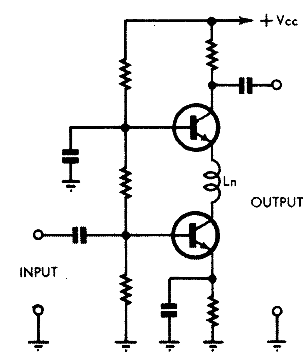
(a) PUSH-PULL LF POWER AMPLIFIER (TRANSFORMER COUPLED)



(c) RF POWER AMPLIFIER (CLASS C)



(b) TUNED LOW LEVEL RF AMPLIFIER (UNILATERISATION SHOWN DOTTED)



(d) CASCODE WIDEBAND AMPLIFIER

Figure 12.6

stabilised R-C coupled stages, of the type shown in figure 12.5. However amplifiers designed for different applications may use other types of coupling, and at times some of the other types of biasing circuit. Four representative examples of other types of amplifier stage are shown in figure 12.6, to briefly illustrate some of the many variations which may be encountered.

Figure 12.6(a) shows a transformer-coupled power amplifier stage of the type used in modest audio applications, and in high power servo amplifiers. As may be seen the stage is a push-pull type, in which two transistors are used in conjunction with centre-tapped windings on the input and output transformers.

For maximum efficiency such a stage is usually biased in either class B or class AB, the latter being used mainly in audio applications where it is desirable to reduce crossover distortion. For class B operation the devices are simply operated with zero base bias, the centre-tap of the input transformer secondary being taken directly to the grounded emitters. Being "normally off" devices the transistors then automatically operate only during alternate half-cycles.

For class AB operation a small forward bias is required, sufficient to allow each transistor to conduct for part of the other's primary half-cycles. While the resultant quiescent operating points of the devices are still quite near the cut-off end of the load line, however, it is usually very desirable to ensure that operation is well stabilised. This follows because such stages often involve considerable power dissipation and temperature rise.

An emitter feedback resistor generally cannot be used, both because of the drop in efficiency which this would introduce, and because it often proves extremely difficult to effectively bypass this resistor at the very low impedance levels involved. Hence the usual bias method chosen is that of temperature compensation using either a thermistor or diodes in the lower section of the bias divider. In the diagram diodes D1 and D2 perform this function, and would normally be arranged to be in thermal contact with the transistors.

Figure 12.6(b) shows a low level RF amplifier stage of the type found in many radio receivers, and in the early stages of transmitters. As may be seen it uses a single transistor connected in common emitter mode, with tuned transformer coupling at both input and output. Capacitor C1 tunes the secondary of the input transformer to the operating frequency, while C2 similarly tunes the output transformer primary.

Typically such a stage uses emitter feedback biasing, as shown, with the emitter resistor well by-passed at signal frequency, and the base bias divider connected to the by-passed "cold" end of the input transformer secondary. Note that whereas the high output resistance of the device allows the collector generally to be connected directly to the "hot" end of the output transformer secondary, the relatively modest input resistance necessitates the base being connected to a tap on the input transformer secondary, in order to preserve the input "Q." An alternative method is for the input transformer to have a tuned primary, with the base

connected to a low impedance secondary.

It may be recalled that the bipolar transistor possesses significant collector-base capacitance: the capacitance associated with the collector junction depletion layer. This provides a potential feedback path when the device is connected in common emitter mode, so that like the triode valve and the FET, it should ideally be neutralised.

In addition, the reverse-bias leakage and saturation current Icbo effectively constitutes a second "resistive" collector-base feedback component, so that for fully stable operation at high frequencies a bipolar transistor must strictly be **unilateralised.** This term means nothing more than the effective conversion of the transistor into an ideal "one-way" device, by neutralisation of both the capacitive and resistive feedback components.

Generally both neutralisation and the more complete unilateralisation can only be applied to fixed-frequency amplifier stages, as found in such applications as receiver IF stages and many low-power transmitter stages. Where the stage involved is tuned over a significant frequency range, it proves difficult to maintain constant compensation for the internal device feedback, and other techniques such as controlled mismatch must be used. One method of unilateralisation used for receiver IF stages consists of a series R-C combination, connected as shown in dashed form in the diagram.

An RF power amplifier stage of the type found in recent low power VHF transmitters is shown in basic form in figure 12.6(c). This type of stage generally employs special devices designed to provide useful power gain at many hundreds of Megahertz. The device usually operates in class C, conducting only on the tips of alternate half-cycles; the resulting collector current pulses are applied to a tuned circuit which then produces a smooth sinewave output by "flywheel" action.

In the type of stage illustrated the collector tuned circuit may not be immediately recognisable, consisting of inductor L and capacitors C1 and C2. It is basically a series resonant circuit, arranged in the form shown to act also as an impedance matching network and harmonic filter.

The reverse bias necessary to operate the device in class C may be applied either from a suitable bias supply, or by means of a "signal derived" bias system as shown. Here the conduction of the base-emitter junction of the device on signal peaks charges the input coupling capacitor, to an extent where the capacitor provides the required reverse bias. Resistor Ra is connected in series with the RFC base return to prevent the capacitor discharging significantly between charging peaks, ensuring effectively constant bias.

A further type of bipolar transistor amplifier application is shown in figure 12.6(d). This is a "cascode" amplifier stage, which like similar configurations of thermionic valves and FETs, often proves very useful in wideband amplifiers. The stage is effectively a combination of a common emitter stage and a common base stage, with the common emitter stage providing relatively high input resistance and significant current gain, while the common base stage provides high voltage gain with wide bandwidth.

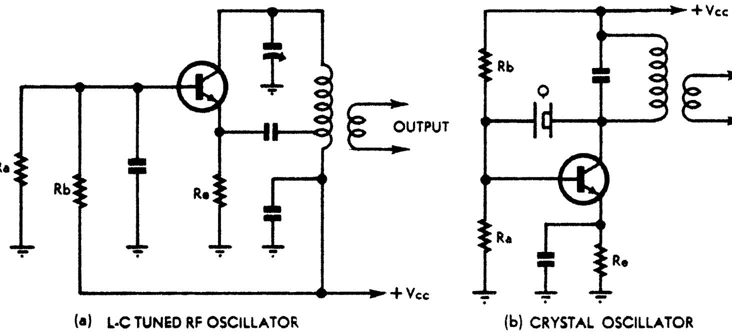


Figure 12.7

Although a cascode stage may consist of two devices with R-C coupling between, it is often possible to connect the two directly as shown and thus save components. The inductor Ln is a stabilising element often found necessary to prevent oscillation due to interaction between the collector and emitter impedances of the two devices at high frequencies.

Being capable of power amplification, bipolar transistors are naturally quite suitable for use in **oscillator circuits.** In fact they find use in oscillators generating signals spanning almost the full range electromagnetic frequency spectrum to which electronic circuitry is currently applied — from a small fraction of a Hertz to many Gigahertz (GHz).

At low and medium frequencies bipolar transistor oscillator circuits generally consist basically of R-C coupled amplifiers, either single stage or multi-stage, around which feedback loops are connected. The circuitry thus involves transistors connected in a manner usually very similar to that shown in the diagrams of figure 12.5. The feedback loops generally consist of R-C networks designed to provide a positive loop gain of unity at the desired operating frequency. In most cases additional circuitry is used to maintain a constant amplitude low-distortion sinewave output, by restricting the peak-to-peak oscillations to the linear portion of the transistor load lines.

High frequency oscillators normally employ either L-C tuned circuits, quartz crystals, tuned lines or similar resonant elements. Hence in this type of oscillator circuit, the transistor is basically used as a power amplifier which compensates for the resonant element losses. It is the resonant elements which oscillate, the transistor merely ensuring that the oscillations are maintained.

Two representative examples of high frequency bipolar transistor oscillators are shown in figure 12.7. In (a) is shown an L-C tuned or "self-excited" oscillator, in which the transistor operates as a common-base amplifier with feedback coupled to the emitter from a suitable tap on the tuned collector winding. Output is taken from the oscillator by means of a low impedance secondary winding. The biasing again employs the emitter feedback method.

Figure 12.7(b) shows an oscillator using a quartz crystal "Q" as the main frequency determining element. In this case there is also an L-C tuned circuit in the transistor collector circuit, for the circuit shown is an "overtone" type in which the crystal is forced to operate in a higher-order mode than the fundamental. The idea is that the collector tuned circuit is adjusted so that the transistor is only able to provide the loop gain necessary for maintaining oscillations at the desired crystal overtone. Hence it is at this overtone that oscillations occur, rather than at the fundamental or other overtone frequencies.

As may be seen the bias used is again of the emitter feedback type, while the output is again taken via a small winding coupled to the inductor of the collector tuned circuit.

There are many other applications of bipolar transistors in linear circuitry, in addition to amplifier and oscillator applications. Bipolar devices are used as detectors, mixers, harmonic generators and frequency multipliers, and also as controlled-value resistor elements in applications such as automatic gain control (AGC), modulators, series and shunt voltage regulators, and current regulators. Unfortunately space restrictions prevent more than a brief acknowledgment here of the existence of these applications, however, and interested readers must be referred to references such as those listed below.

SUGGESTED FURTHER READING

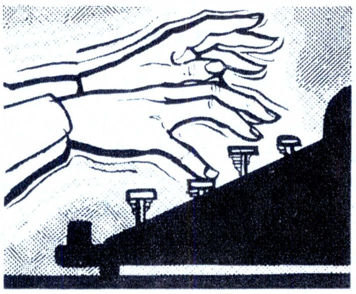
BRAZEE, J. G., **Semiconductor and Tube Electronics,** 1968. Holt, Rinehart and Winston, Inc., New York.

CHERRY, E.M., and HOOPER, D. E., **Amplifying Devices and Low-Pass Amplifier Design,** 1968. John Wiley and Sons, New York.

CLEARY, J. F., (Ed.) **General Electric Transistor Manual,** 7th Edition, 1964. General Electric Company, Syracuse, New York.

WALSTON, J. A., and MILLER, J. R. (Eds.) **Transistor Circuit Design,** 1963. McGraw-Hill Book Company, Inc., New York.

WOLFENDALE, E., **Transistor Circuit Design and Analysis,** 1966. Heywood Books, London.



FORUM

X-rays from TV sets — Australian tests

Last month we referred to an article in "The Australian" newspaper about the allegedly dangerous level of X-ray type radiation from television receivers. We expressed strong reservations about the validity of the statements and, this month, our view is supported by a letter from the Department of Public Health in New South Wales.

Conducted by the Editor

The article in "The Australian," written by Phillip Adams, was based on findings by an American scientist, John Ash Nott.

Nott reported that rats, caged in front of either a monochrome or a colour television receiver, sickened and died from what he assumed to be the effects of X-ray radiation.

The article went on to complain, in effect, that the major media had deliberately suppressed Nott's findings, leaving it to the "underground" press to publish them and to reveal other relevant matters, such as the recall of colour receivers in the U.S.A. known to radiate X-rays.

We pointed out that Nott's report was at complete variance with the majority findings and that investigators generally had not been able to measure significant radiation from monochrome receivers, using the most sensitive detection equipment available.

Further, that the subject of radiation from colour television receivers had been freely discussed in the technical press, the world around. If the major news media did not splash it over their front pages, it was not a matter of suppression; rather, it was simply not big enough news, in their opinion, to warrant such coverage. The electronics industry had discerned a problem and taken corrective measures before any apparent harm had been done.

We went on to suggest that Nott's unfortunate rats had suffered, not from X-ray radiation but from the (for them) intense sonic output from the line deflection components.

As far as we were concerned, the "underground press," whatever that means, was welcome to the story!

Having expressed ourselves thus, we were most interested to receive a letter from the Department of Public Health (N.S.W.) over the signature of Mr H. M. Whaite, Officer-in-charge of the Radiation Branch. The letter runs as follows:

Dear Sir,

I was interested to read your comments in the April issue of "Electronics Australia" on an article which recently appeared in a daily newspaper. It concerned radiation hazards from television receivers and, in my opinion, you have analysed the subject matter very effectively.

A Sydney woman wrote to us after reading this article, and my reply, which may be of some interest to your readers, confirms your conclusions.

"Dear Madam,

In reply to your letter of 23rd February concerning radiation hazards from television sets, we have measured radiation dosages from a number of black-and-white television sets and have found them to be negligible.

We have not measured radiation dosages from many colour television sets in this State, since they are few in number and mainly used in experimental work. However, American experience is that the main hazard arises from what is known as the shunt regulator tube, when operated at voltages over 25,000 volts. Black-and-white television sets operate at a maximum of 17,000 volts, and do not employ a shunt regulator tube, hence their comparative freedom from radiation emission.

Remedies suggested in America have involved modification of the shunt regulator tube and checking of the alignment of its internal components. Shielding of the tube so as to absorb its radiation is a simple precaution.

The commonly accepted limit of dosage rate is 0.5 milliroentgen per hour at 5 centimetres (2 inches) from the outer surface of any home television receiver. Even if one needed to approach this closely to the surface, it would be permissible to remain there for 20 hours per week to receive the 10 milliroentgens per week permitted to members of the general public. In fact, by sitting at a distance of even a couple of feet, this dosage would be reduced considerably, and is normally much less than that received from "background" radiation.

Some tests carried out in the United States showed that, over a small area, the radiation beam at a distance of seven inches below the shunt regulator tube was up to 8,000 milliroentgens per hour. On this basis, a hand placed under the set would receive a week's dosage allowance (1,500 milliroentgens) in less than 10 minutes. It is, of course, unlikely that a hand would be so exposed, but there is a potential hazard, and it was found possible, by slightly modifying the tube, to reduce this dosage to a negligible amount."

Finally, I might mention that some consideration is currently being given to the production of a national "Code of Practice" covering the emission of radiation from colour television receivers. Its purpose will be to ensure that manufacturers virtually eliminate stray radiation from these sets, and thereby avoid the debacle which occurred in the United States and Canada where, as stated, a large number was withdrawn from service.

Yours faithfully,
H. M. Whaite.

"X-rays or no x-rays, I reckon TV is a time waster." (TV Times)

By coincidence, during the month, we received notice of an international symposium on the subject: "Radiological Protection Problems Associated with Parasitic X-ray Emission from Electronics Products."

The symposium is to be conducted by The Centre of Atomic and Nuclear Physics of the Faculty of Science of the University of Toulouse. The date: November 3-6, 1970. Those requiring further information may write to:

Mr E. A. Hampe,
Commission of the
European Communities,
Directorate-General
for Social Affairs,
Directorate for
Health and Safety,
29 rue Aldringer,
LUXEMBOURG
(G.D. of Luxembourg).

According to the literature, the aim of the Symposium is: "To enable electronics engineers, technical inspection bodies, public health and occupational-safety authorities to carry out ex-

SOUTH COAST GHOST PROBLEM

Dear Sir,

Attached please find a photograph of the top of the mast erected on "Nanny Goat Hill" Cooma from the A.B.C. translator Channel "0" to serve the town of Cooma.

The translator re-transmits from ABSN-8 (Cooma-Bega) at Brown Mountain, near Nimmitabel. N.S.W.

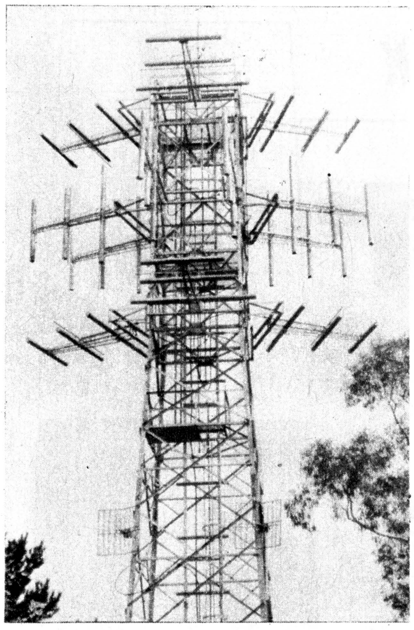
The translator at Cooma, which came into operation in October, 1969 is unique in Australia in that it transmits on both vertical and horizontal polarity.

The parent station uses vertical polarisation but it was found that the signal on Channel 8 was prone to severe ghosting due to the hills which surround Cooma.

The translator was designed so that householders who already had vertical antennas could use them for the translator, or new installations could be made using horizontal equipment which was less prone to ghosting.

The sidelight on the installation was that, following recriminations between the local trade and the Broadcasting Control Board (See Electronics Australia, May 1967, Pages 88-92), in which it had been suggested that the problem with ABSN-8 was the receiving antennas and installations and not the transmitter, the P.M.G. had difficulty obtaining a ghost-free picture at Nanny Goat Hill from Brown Mountain.

Eventually the problem was largely



overcome by the purchase from a local retailer of a phased array which is now mounted above the P.M.G.'s Tower — the same type of antenna as sold by the trade in Cooma for several years.

C. C. Maher (Development Officer,
Cooma Visitors Centre.)

---

changes of views and experience on this subject so that they can draw up an inventory of the radiological protection problems and seek for suitable technical and administrative solutions."

The provisional agenda includes the following items:

- Possible sources of parasitic X-rays, and experimental results;
- Methods of measuring soft X-ray emission;
- Biological aspects of exposure to soft X-rays;
- Means of reducing parasitic X-ray emission;
- Performance standards, testing and inspection methods for electronic products.

Included in the above will be a discussion of the problems associated with parasitic X-ray emission from electronic products such as rectifying valves, transmitting valves, thyratrons, klystrons, magnetrons, electron microscopes and television receivers.

Well, there it is for those who want to follow up the subject further. A trip to Toulouse might also be just the thing for:

- Feature writers seeking new scare material;
- Businessmen seeking a tax deduction;
- Public servants seeking to do their duty.

Pity it had to be November, though!

Changing the subject, we have a letter from a reader in Numurkah, Victoria, who has this to say:

Dear Sir,

An experience in importing from Hong Kong may be of interest to your readers.

I.E.C. Hong Kong advertised in the "Electronics Australia" September, 1969 issue. I wrote for a catalogue which duly arrived. It was perused at work by members of my staff.

One of them ordered three transistor-6 kitsets at a cost totalling about $10. When the kitsets arrived, there was a custom duty owing of $44. When I queried customs, I was informed that the import duty on radios, or on kitsets which were classified as complete radios, was 45 per cent plus $10 per set.

I have another brochure from a party in Brisbane where, if I pay $10, he will tell me how to import direct from Hong Kong at fantastically cheap prices.

What I would like to know in the import game is who cons whom, as these same radios can be bought in any radio shop for about $10, which includes profit margins plus 25 per cent sales tax. Customs must be a very flexible organisation.

Unfortunately, my staff member has kissed his $10 goodbye and put it down to experience. He has the consolation that he might as easily have ordered a hundred kitsets instead of just three!

T.C. (Numurkah, Vic.)

When this letter came to hand, I had to search through the September issue to find the advertisement mentioned. It turned out to be a small insertion in the classified section, which explains why it had passed unnoticed. However, there is no suggestion that it is any-

thing but a perfectly legitimate advertisement from a firm interested in exporting electronic components.

And, indeed, there is no doubt that electronic components are available from overseas sources at what are, to us, very cheap prices. Would you believe IF transformers for less than 10 cents apiece? A complete IF assembly, needing only input output and supply leads for about $1.50? Crystals, ground to order, for less than $2?

Six-transistor receivers, being cleared through the shops on Hollywood Boulevarde for $3.99?

These are things that I happen to have seen personally, or otherwise run across during the past couple of years. Those fortunate to be sharing in our "Technitour" during June-July, will probably be able to note at first hand the price levels of equipment emerging from factories in Taiwan.

In Australia, as in many other countries, we are isolated from such price levels by tariff and other barriers. This is exasperating for the hobbyist and the professional importer alike but it would appear to be an essential measure if we are to preserve our industry and our standards of living. (This could lead to a long argument, of course, which it is not for us to pursue here.)

The basic fact is that, whether we like it or not, customs duties do operate in relation to a wide range of imports and they have to be taken into account.

People travelling overseas are well advised to find out beforehand what they can take into countries which they propose to visit and what they can bring back into their own, when they return.

In exactly the same way, anyone seeking to import items, whether as freight or through the post, should check on the customs situation beforehand, to see whether the proposed transaction is worthwhile. By no stretch of imagination is it the responsibility of the exporter, who is concerned only with obligations to his own country.

The young man referred to in the letter certainly learned the hard way. It is unfortunate that he did not stop to think that customs duties might be involved when importing items from Hong Kong. It is equally unfortunate that no one else apparently bothered to mention it to him.

Radio and television receivers, either built up or in kit form, face a stiff customs barrier. For decades, the manufacture of these items has formed the backbone of our electronics industry, which makes very certain that the Government does not lose sight of the fact. But protection notwithstanding, local manufacturers still cannot compete effectively with some of the imported products.

T.G. says that "these same radios can be bought in any radio shop for about $10" — this presumably in Australia. All I can say is that I haven't seen them at anything like this price.

Undoubtedly, private individuals do manage to bring in a few electronic components, through the mail and in small quantities. They score from the fact that it is neither economical nor possible to inspect every letter or every small package addressed to private individuals. Even if it were, it would be far too tedious to calculate and collect a few cents here and a few cents there.

As for the man in Brisbane, I

wouldn't have a clue as to what information he might be offering for $10. It may be very useful and perfectly legitimate information about the range of goods which can be imported, either duty-free or at an attractively low rate of duty. It may or may not include electronic components.

However, details aside, the letter from T.C. will undoubtedly have fulfilled the writer's intention — alerting readers to the fact that bargains from Hong Kong may turn out to be anything but bargains if they are subject to high import duties.

Colour television

During early April, there were some raised eyebrows when the "Sydney Morning Herald" carried a story by Ian Evans about a Sydney viewer watching certain television programs in full colour. At first glance it looked like an April leg-pull but it wasn't.

The person mentioned in the story was Mr Victor Barker, a licensed radio amateur, and a technician on the staff of ATN Channel 7 in Sydney. Prior to coming to Australia, he had gained experience in colour television and had on hand a colour television receiver designed for the PAL system.

When ATN 7 (and doubtless other stations) began putting to air original colour tapes of overseas shows, Vic Barker realised that the tapes would necessarily contain the original chrominance signals. Certainly, the station's normal pulse shapers would shave off the reference bursts for the colour subcarrier but if, by any other means, the carrier supplied by the receiver could be maintained in suitable phase relationship with the chrominance sidebands, the colour information could be decoded and used in the normal way.

Having an idle colour receiver on hand was three-quarters of the battle but full marks must nevertheless go to Vic Barker for waking up to the presence of the "accidental" colour signals and for devising circuitry which would provide a suitable sub-carrier.

However, his accomplishment must necessarily fall short of the "genius" rating which was implicit in the "Sydney Morning Herald" article.

Station engineers and The Australian Broadcasting Control Board were fully aware that chrominance signals interleaved in the video information would ride through on a normal monochrome transmission, even if a trifle mangled by the less stringent performance standards of monochrome equipment. They had presumably relied on the fact that: (a) The chrominance signals would not be noticed on monochrome receivers and (b) the signals could not be used, anyway, in the absence of a reference burst on the "back porch" of the sync. pulse.

This last assumption was not entirely valid, as Vic. Barker has demonstrated, and as reference to the literature would have shown.

It would appear that the early sponsors of the PAL system regarded the reference burst as a desirable feature and one that, in general, would simplify the design of PAL colour television equipment. However, for situations where phase relationships had become suspect, they foresaw an advantage in downgrading reliance on the reference burst and relating the carrier re-insertion oscillator more to the actual chrominance signals.

This was the concept behind the so-called "Perfect PAL" receiver.

We haven't attempted to trace the bibliography on the subject but one article which happened to be in our files was in the "NTZ Communications Journal," Volume 3/1964, Number 6. Translated from the rather forbidding German form, this journal is the "Proceedings of the Communications Group within the German Electrical Engineering Association." The article was entitled: "The PAL Colour TV System — Basic Principles of Modulation and Demodulation."

But, quite apart from possible arguments about who first thought of what, the Herald article may well have stirred up something of a political hornets' nest. Now that they have been alerted, any engineer who has access to a developmental PAL receiver can fairly obviously contrive the extra circuitry and make use of chrominance information, when available in what are ostensibly monochrome transmissions.

I can't imagine that this prospect will make the Australian Broadcasting Control Board very happy, because they have presented a very stern face, to date, to the radiation of unauthorised colour information.

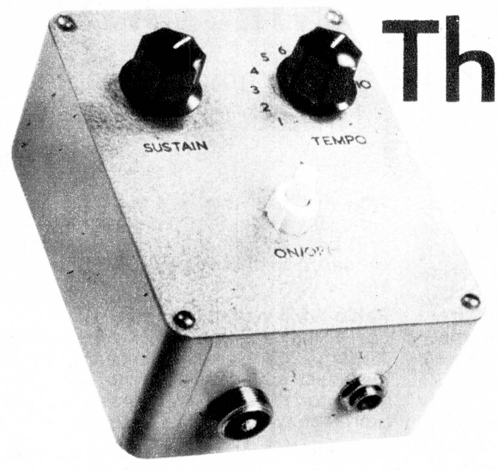
But, on the other hand, what do the stations do when the most practical form for some imported programs is a video tape with the chrominance information inextricably interwoven with the higher frequency video?

Are the stations to lop the whole lot off and offer, as a result, a degraded monochrome picture?

Or will they be required to negotiate for tapes or kinescopes deliberately prepared without the vital colour information — assuming that these exist?

Or are we getting so close to the colour era that the ABCB will ignore what is a purely temporary problem?

A simple musical percussion generator



The AUTODRUM

In this article we introduce another electronic percussion instrument which we have named the Autodrum. As in the case of the Electronic Bongos featured last month, it is based on the twin-T oscillator. In addition to being keyed manually, it has the facility of automatic triggering at any desired rate.

By LEO SIMPSON

Essential to almost any small musical "combo" is a rhythm section, consisting, usually of snare and bass drums and a set of high-hat cymbals. The instrument we describe in this article could conceivably replace the bulky bass drum. It is accommodated in a small diecast metal box so that it can be carried in a briefcase instead of a station wagon. As with the bass drum it can be pedal operated but it has the additional facility that it can be automatically keyed at any desired rate.

Alternatively, the Autodrum could be used to accompany a solo piano or electronic organ. With a powerful amplifier and loudspeaker to match, it puts out a beat that anyone could follow. Use it over the school P.A. system and it will make those lazy schoolboys look like automations. Lastly, if you listen to it for half an hour, as the author did when developing it, it will give you a headache!

The bass drum is synthesised by the same method as described in the article on the Electronic Bongos, referred to above. We set up an electrical analogue: a circuit which "resonates," or produces a wave-train when an electrical impulse is applied to it, the electrical impulse being analogous to the physical blow applied to a drum. The circuit also requires a means of determining the damping of the resonance, so that the "quality" of the resonance can be altered to simulate that from the acoustic instrument.

A circuit which lends itself to synthesising percussion instruments is the Twin-T oscillator, so-named because of the configuration of the twin RC phase-shift networks. In this particular instrument, the oscillator is set into the "quiescent" mode, i.e., just on the point of oscillation, with the aid of a 25K potentiometer in the emitter load of the transistor. An electrical impulse applied to the juction of either cf the T-networks or to the base of the transistor will shock the circuit into brief oscillation. The degree to which the oscillation is sustained will depend on the setting of the potentiometer.

If the potentiometer is set for maximum resistance, the oscillation will be very short — only a few cycles. If the potentiometer is set so that the oscillator is just into the quiescent region, the oscillation will be quite long, probably 20 or more cycles. Beyond this again, the stage will go into full oscillation, which would be totally undesirable for the present purpose.

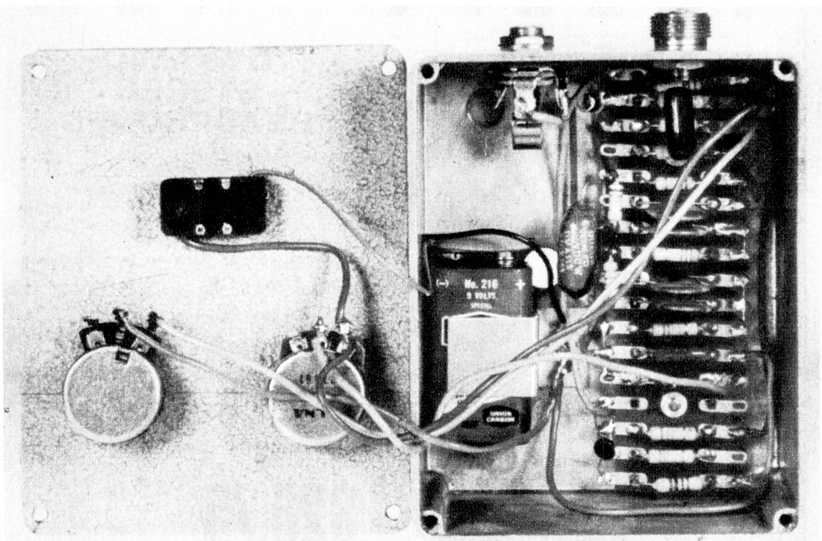
The waveforms shown in figure 1 illustrate the three possible modes of oscillation possible with the Twin-T oscillator. Figure 1(a) shows a continuous oscillation at constant amplitude. Figure 1(b) shows a lightly damped oscillation produced with the oscillator set just into the "quiescent" zone. Figure 1(c) shows a heavily damped oscillation produced with the potentiometer set for a very short "sustain."

The circuit may be triggered into oscillation by the same method as used in the Electronic Bongos, i.e., with the aid of touch plates connected to the junction of one of the T-networks. However, since a bass drum is usually pedal-operated, we have suggested a different method. The circuit is triggered into oscillation by a DC pulse into one of the T-networks. This can be initiated either with a pedal-operated switch or with the auxiliary triggering oscillator which we have incorporated.

The triggering circuit is a relaxation oscillator featuring a three-terminal PNPN device from General Electric which is called a "programmable unijunction transistor" (PUT) with the type number D13T1. The theory of PUT operation was discussed in the article, "Keeping up with Semiconductors" in the December, 1968, issue.

In actual fact, the PUT is closer in mode of operation to a thyristor than to a conventional unijunction transistor. For the purpose of this article it will suffice to know that the PUT can be arranged to function as a relaxation oscillator, as one of its many possible applications. The three terminals of the PUT are designed as Anode, Anode Gate and Cathode (A, G, and K).

There is no reason why the reader should not experiment with a triggering circuit using a conventional UJT, although there may be some problems in achieving the desired low repitition rates. For our part, the other good reason for using the PUT is that it is

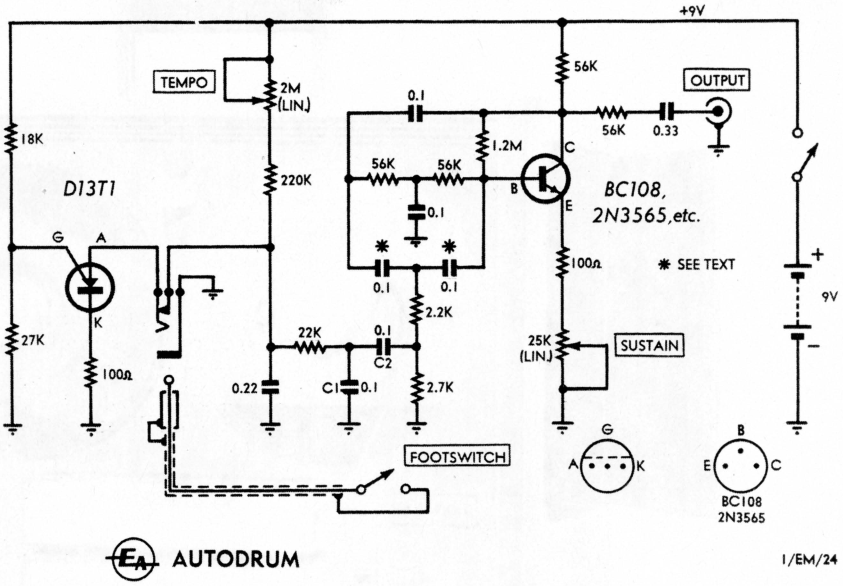


A view of the layout inside the case of the Autodrum. As viewed here, the Sustain control is on the left and the Tempo control on the right. Above them is the On/Off switch. At the extreme top right is the output connector and, alongside it, the jack for individual triggering.

cheaper than comparable UJTs anyway!

The time constant of the PUT oscillator, and hence the repetition rate, is determined mainly by the 0.22uF capacitor and the sum of 220K resistor and 2-megohm potentiometer (connected as a variable resistor). The 0.22uF capacitor charges exponentially toward the supply voltage via the resistors until it reaches the firing voltage of the PUT. The firing voltage of the PUT is set by the ratio of the 18K and 27K resistors and this is how the title "Programmable" arises. When the PUT fires, the 0.22uF capacitor is discharged very rapidly. It then begins to recharge and the whole sequence is repeated indefinitely. The result is a sawtooth waveform.

The repetition rate of the PUT oscillator shown ranges from 50 beats per minute to over 220 beats per minute, which should be more than adequate. The range can be increased at the high end by decreasing the 220K resistor and it can be decreased at the low end by using a 5-megohm potentiometer.



The circuit diagram of the Autodrum. It uses a twin-T oscillator to produce the "drum" sound and a PUT pulse generator to provide the automatic repeat feature.

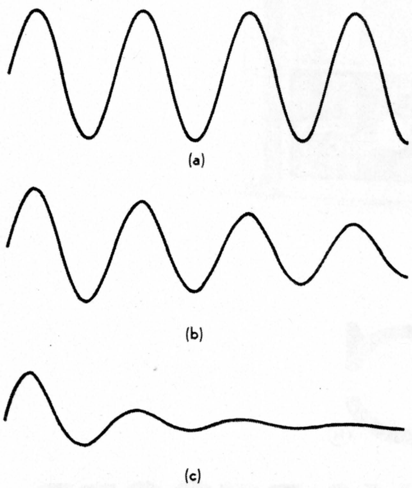


Figure 1

The above waveforms show the three modes of oscillation possible with a Twin-T oscillator. (a) is continuous; (b) is lightly damped and (c) is heavily damped.

When the PUT fires it also discharges C1 via the 22K resistor. This applies a negative DC pulse to one of the T-networks of the drum oscillator via C2, so that it is shocked into oscillation. Thus the PUT oscillator is a simple way of triggering the Twin-T oscillator at a regular but adjustable rate.

If the drummer wishes to key the Autodrum with a foot-operated switch, the PUT oscillator can be effectively disconnected from the circuit by inserting a phone jack in the socket. Using the footswitch now discharges the 0.22uF and C1 in the same way as the PUT does, so that the Autodrum can be keyed by a player instead of at the constant rate provided by the PUT oscillator.

The Autodrum could be arranged to simulate the Tom-tom by changing the 0.1uF capacitors on the circuit diagram marked with an asterisk to 0.047uF. Other variations are possible — just vary the capacitors.

The Autodrum can be used with almost any amplifier, provided it does not overload the amplifier's input. The more powerful the amplifier, the better; the same can be said about the size and power handling capability of the loudspeaker. For the best results, it should be used with a high power guitar amplifier and matching loudspeaker system.

The output signal from the Autodrum is approximately 0.5 volts RMS, which is enough to drive almost any amplifier to full power using the "pick-up" or "auxiliary" input. Do not attempt to feed it into a "microphone" or low-level "guitar" jack, as it will most likely overload the input stage.

A diecast metal box measuring approximately 4-5/8 x 3-5/8 x 2in, is used to house the components. All of the components, with the exception of the potentiometers, are mounted on a 17-lug section of tagboard. Layout is not critical, but we suggest that beginners use the wiring diagram supplied to simplify construction and minimise errors.

When drilling the diecast box, use a sharp drill at high speed and a low rate of "feed" (i.e., do not put too much pressure on the drill). Preferably, use a drill stand. If care is not taken when drilling, the box may be cracked.

The battery is a small 9-volt type, Eveready 216 or equivalent. The current drain will depend on the setting of the Tempo control but it will always be less than 0.5mA so that the battery should have a very long life. If the constructor desires, the circuit can be operated at voltages below 9 volts, although we would suggest a minimum of 6 volts to ensure adequate output signal.

We have left the details of the footswitch to individual constructors. It must be reliable and rugged. Several ideas are suggested. The footswitch from an electric sewing machine could possibly be adapted. Alternatively, a unit could be built using a small magnet and reed switch; this would have the very obvious advantage of being virtually free from contact troubles.

The stop-start facility could also be operated by footswitch instead of using the push on/push off switch that we used in the prototype.

The Autodrum could even be triggered by using the hand to interrupt a light beam which actuates an LDR/

PARTS LIST

1 Diecast utility box, 4-5/8 x 3-5/8 x 2 inches.
1 push on-push off switch.
1 phone jack socket.
1 17-lug tagboard.
1 output socket.
1 battery (Eveready 216 or equivalent) and connector to suit.
1 25K (lin) potentiometer.
1 2M (lin) potentiometer.
1 BC108, 2N3565 or equivalent silicon NPN transistor.
1 D13T1 programmable unijunction transistor.
(Note: The General Electric D13T1 can be obtained direct from Messrs Watkin Wynne Pty. Ltd., 32 Falcon Street, Crow's Nest, 2065, or from most kitset suppliers.)

CAPACITORS
(Voltage ratings higher than 9V will suffice)
1 x 0.33uF, 1 x 0.22uF, 6 x 0.1uF, all ceramic or polyester.

RESISTORS
(½ or ¼ watt rating)
1 x 1.2M, 1 x 220K, 4 x 56K, 1 x 27K, 1 x 22K, 1 x 18K, 1 x 2.7K, 1 x 2.2K, 2 x 100 ohms.

SUNDRIES
2 knobs, footswitch (see text), screws, nuts, battery clamp, hookup wire, solder, etc.

TEAC®

BI-DIRECTIONAL PLAYBACK & RECORD A2060 STEREO TAPE RECORDER

Bi-direction gives you continuous playback and record in both tape directions automatically. You can have longer hours of continuous music. There is no more need to interchange the reels. All you do is record in the normal forward direction. At the end of the reel the A-2060 automatically reverses direction, changes tracks, and continues to record. The same thing happens during playback. It's not just a gimmick. The A-2060 is a quality built recorder with many unique features. Why not write to us for full report, including laboratory test data.

SPECIFICATIONS

- Four heads.
- 4-pole hysteresis synchronous motor.
- Frequency response
  7½ i.p.s. 30-20,000 Hz
  3¾ i.p.s. 30-15,000 Hz
- Power output 20 watts (RMS) 10 per channel.
- Dimensions
  16⅛" x 17⅝" x 8½".
- **Price $399** (Aust.).

AUSTRALIAN MUSICAL INDUSTRIES PTY. LTD.
155 Gladstone St., Sth. Melb., Vic., 3205. Phone 69 7281. Telegrams AMUS Melb.

RETAIL ENQUIRIES:

Vic: Brashs Pty. Ltd. 63 6701 Melbourne & Suburbs
Suttons Pty. Ltd. 60 1201 Melbourne & Country
Southern Sound Moorabbin. 97 7245

NSW: Convoy International Pty. Ltd. Sydney. 29 6475

SA: Ern Smith & Co. Ltd. Adelaide. 51 6351

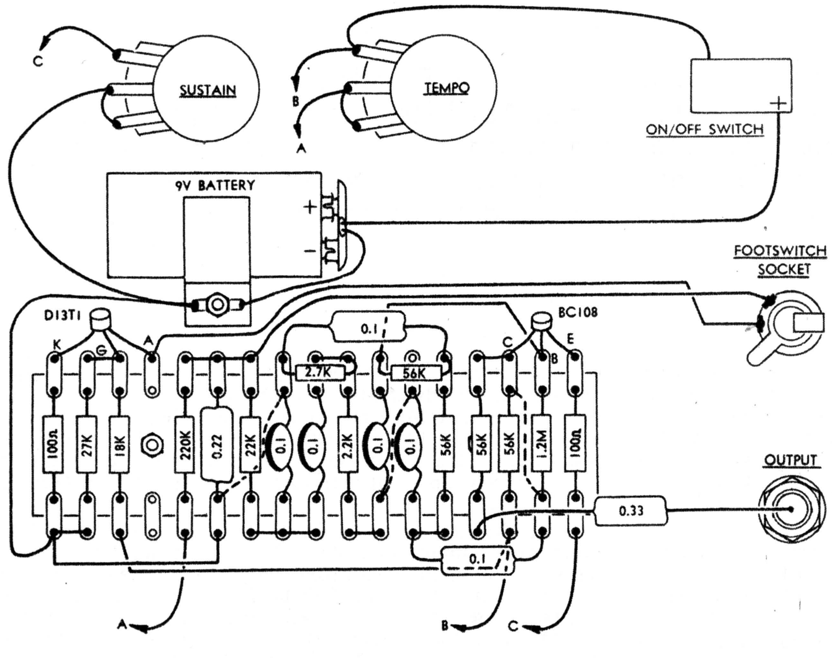
WA: Albert TV & Hi-Fi Centre Pty. Ltd. Perth. 21 5004

Tas: B.B.C. Radio Centre Pty. Ltd. Burnie. 31 4415
Wills & Co. Launceston. 2 4641

Qld: Brisbane Agencies Audio Centre Brisbane. 2 6931
King & King Brisbane. 2 7760

AMI-115

DIAGRAM SHOWS COMPONENTS AND WIRING



The assembly of the Autodrum will be a straightforward process if this wiring diagram is followed closely.

relay combination, this would introduce an element of "mystery" into its operation though it will also introduce a substantial degree of complication.

When assembly is completed, connect the Autodrum to an amplifier and loudspeaker. Switch on and turn the sustain control fully clockwise. The drum oscillator should be operating continuously at about 60Hz. Now rotate the sustain control anticlockwise until the oscillator just stops. Varying the Tempo control will now control the rate at which the Autodrum beats. Critical adjustment of the Sustain control will make the Autrodrum sound like Bass drum or a kettle drum.

Finally, a word to avid experimenters on how the basic circuit described here could be expanded to make a simple rhythm generator. Two Twin-T oscillators would be needed, each one having an associated relaxation oscillator to trigger it. One relaxation oscillator would be run from the output of the other relaxation-oscillator, so that it acts as a frequency divider. One relaxation oscillator would provide the basic beat while the other provides the accented beat, on a different note.

Addendum to Electronic Bongos

The article on the Electronic Bongos in last month's issue of "Electronics Australia" has apparently created much interest among readers, two of whom have suggested worthwhile modifications.

The first of these was submitted by Mr K. H. Young, of Nunawading, Victoria, concerns the hand-held probe to which is connected the positive supply line. As an alternative, a third touch plate is installed between the existing two plates. The third plate is connected to the positive supply and the 22K probe resistor may be omitted. In playing the Bongos, the thumb of one hand would rest permanently on the centre touch plate while the fingers tapped the oscillator plates in the normal way.

The second modification was suggested by a reader during a telephone conversation and unfortunately, he did not give his name so that we could acknowledge it. His suggestion involves the use of a stereo amplifier and associated loudspeaker systems. Instead of mixing the two oscillator signals together via 22K resistors, each oscillator signal is coupled individually via a 22K resistor and 0.1uF capacitor to each channel of the stereo amplifier. In this way, the subjective level of each "drum" can be adjusted for equal intensity with the aid of the balance control.

If the amplifier had separate tone controls for each channel, this would enable further adjustment to obtain the best effect from each "drum."

NOTES AND ERRATA

INTRODUCTION TO DIGITAL FREQUENCY METERS (February, 1970): In figure 5(a), on page 49, the connections to the J and K gating inputs of elements FF2 and FF4 were both shown incorrectly transposed. In both cases the connections should be reversed.

27MHz IC SUPERHETERODYNE RECEIVER (February, 1970). In the wiring diagram (page 61) the transistor numbers, T1 and T2 are reversed. Fortunately, it has no technical significance as both transistors are of the same type. Both transistors are fitted with a fourth "shield" lead, which should be connected as shown in the wiring diagram.

THE DEVELOPMENT OF

This article may be regarded as a sequel to "The Development of Systeme Internationale" which we presented in the April issue, since it deals with the closely related subject of reference standards. Although there is a certain amount of overlap between the two articles, to preserve the continuity of the text we have not attempted to delete this material.

By L. C. Debnam

One of the greatest problems which arises when communicating information is to find a common basis to which to refer. The Hieroglyphic writing of the ancient Egyptians was undecipherable until the discovery of the Rosetta stone in 1799, on which the same text was written in Hieroglyphic, Demotic and Greek, and as Greek was known this acted as a common basis to aid the translation of the Hieroglyphics.

Similarly common bases of measurement are required if technology is to advance, and chaos would reign if each manufacturer used his own system of units for measurement.

At various periods in history attempts have been made to obtain standards of measurement, but it was not until the latter half of the eighteenth century that concerted efforts were made to devise standards by which all physical quantities may be measured. This first "total standards" system was devised at the time of the French revolution. In 1790 the French National Assembly appointed a committee for the purpose, and the metric system was initiated by the Paris Academy of Sciences in 1791.

The most important measurement to be initially standardise was the measurement of length. This was to be based on the distance along the surface of the Earth from the equator to the North Pole, this distance to be 10 million "metres." It was known from astronomical measurements that the distance between Barcelona (in Spain) and Dunkerque (in France) was a little more than one tenth of the distance of the North Pole from the equator, so between 1792 and 1799 this distance was surveyed under the direction of Jean Baptiste Delambre. The surveyed distance was divided by 1075,039 and this length, the metre, was inscribed on a bar for easy reference. Unfortunately, due to surveying errors the metre is not exactly one ten-millionth of a quadrant of the Earth's meridian as originally proposed.

The unit of length was then used to define the unit of mass, and one kilogram was defined as the mass of 1,000 cubic cenitmetres of water at its maximum density (4°C). The volume, 1000cc, was called the litre.

From these units of length, volume and mass the metric system of measurement started, and during the first quarter of the nineteenth century was adopted by Italy, Belgium and Holland. In the 1860s it became legal to use the metric system in the British Empire and the United States. There was no unit of time in the original metric system but for centuries astronomers had used 1/86,400 of the mean solar day as "one second" and this was in general use throughout the world.

The unit of temperature, the degree Celsius (also known in English as the degree Centigrade), was originally proposed in 1742 by Anders Celsius of Sweden as one-hundredth of the temperature difference between melting ice and boiling water, although in Celsius' original system ice was at 100° and boiling water at 0°. It is not generally known that the Fahrenheit temperature scale (named after the German Gabriel Daniel Fahrenheit, 1686-1736) is also based on the fraction 1/100, with "zero" being the lowest temperature obtainable with a mixture of ice and salt, and "100" being the temperature of the human body.

Due to dissatisfaction with the original definitions of the metre and kilogram, and the need for standards in other measurements, the French Government arranged a conference in 1870 to determine standards for a unified measurement system, and in 1875 a number of countries signed the "Treaty of the Metre." This treaty established the International Bureau of Weights and Measures (Comite International des Poids et Mesures) and the General Conference on Weights and Measures (Conference Generale des Poids et Mesures). The International Bureau of Weights and Measures is the custodian of the standards for measurement agreed upon at periodic meetings of the General Conference.

At the first General Conference the metre and kilogram were adopted as units of length and mass, the second (as 1/86,400 of the mean solar day) was adopted as the unit of time and the degree Celsius for temperature measurements. These units, along with the Ampere (for electric current) and the Candela (for light intensity) are the six main units adopted by the General Conference on Weights and Measures, but the methods of determining these units have changed considerably since the first Conference.

The measurement of time was accepted as a fraction of the mean solar day until it became apparent from the use of quartz-crystal controlled clocks that variations in the length of the day were greater than had been assumed, varying as much as one part in 10 million, or three seconds per year. Even averaging the day throughout the year was found to be unsatisfactory as the length of each year was found to vary. In 1956 the International Burean, acting on the authority of the 10th (1954) General Conference, redefined the second in terms of the year A.D. 1800. As this year had already passed its period could be accurately determined by astronomical means and after four years' work this was completed to within four parts in one thousand million. In October, 1960, the 11th General Conference ratified this definition and urged that work proceed on finding a more accurate atomic standard.

The U.S. National Bureau of Standards had started work on an atomic standard in 1948. Their early efforts were based on atomic vibrations of the ammonia (NH_4) molecule but in the 1960s they found that even better results could be obtained by relating time to motions within the atom itself. This culminated in the development of the Caesium Beam Resonator which resonates at 9,192.631,77MHz, to an accuracy better than one second in 6,000 years. In October, 1967, the 13th General Conference redefined the second in terms of this standard. Work is at present being carried out to construct even more accurate clocks, such as the hydrogen maser clock which promises an accuracy 100 times better than the Caesium Standard.

One of the major difficulties in the use of atomic standards for time measurement is that such clocks may be used only for defining and measuring **periods** of time, and cannot be adequately employed to determine a specific **instant** in time. An instant in time can only be determined by reference to some event which occurs, and for this purpose astronomical observations are required to determine instants of time.

In Australia such time instants, obtained from astronomical observations, are determined at the Mount Stromlo (A.C.T.) observatory by photographing certain stars at 24-hour intervals, scanning the photographic plates by photoelectric methods and processing the data with an I.B.M. 1620 computer. Atomic scale at Mount Stromlo is kept with a Hewlett-Packard 5060A caesium beam standard, and time pulses are exchanged by landline with the Deep Space Station DSN42 at Tidbinbilla (A.C.T.); P.M.G. standards in Melbourne; and the C.S.I.R.O. in Sydney. The phase of Australian standards is continuously compared with overseas sources to detect minor variations.

A difficulty arises in comparisons of astronomical

REFERENCE STANDARDS

periods and atomic periods in that they do not compare precisely, but vary both systematically and periodically. These variations occur because of time-dilation relativistic effects of the motion of the Earth, as predicted by the Special Theory of Relativity, and the gravitational doppler effect of the General Theory of Relativity, caused by the gravitational attractions between the Earth, Sun, Moon and Jupiter.

The kilogram was defined at the third General Conference in 1901 as:

"Le kilogramme est l'unite de masse; il est represente par la masse du prototype international du kilogramme." i.e., it is represented by a platinum-iridium cylinder kept at the International Bureau at Sevres, near Paris. All signatory countries to the Treaty of the Metre possess copies of the international prototype which are accurate to one part in one hundred million. Presently there is no fundamental substitute for this prototype kilogram as atomic measurements cannot be made to the accuracy obtainable on a precision balance and the 1901 definition still holds, although recent advances in X-ray crystallography have suggested a method of determining mass by counting the number of atoms in a crystal. This method is not yet practical because of the difficulty involved in producing a perfect crystal of reasonable size.

Copies of the original length standard were initially made by laborious microscopic comparison with the lines inscribed on the original, but such a task has now been superseded by methods of interferometry. Interferometry involves counting "fringes of interference" of a light beam, and may be readily observed with two glass plates and a source of monochromatic light. If monochromatic light (i.e., light of a single colour) such as is available from a sodium discharge lamp is used to illuminate two glass plates placed in contact at one edge and separated by a piece of paper at the other edge, as in figure 1, interference fringes may be observed.

In this diagram light from the source is reflected from the top sheet of glass at B. More light passes through the top sheet of glass at C, is reflected from the bottom sheet of glass at D and joins the other (reflected) light at B. If the two light rays are in phase at B (i.e. if their peaks occur at the same time) the light observed will be more intense than the original rays as the effects are added, but if the rays are 180 degrees out of phase with each other at B, the effects cancel and no light is observed. The criterion for the two rays to be in phase at B is that the path-length A-D-B is an exact number of wavelengths different from the length AB, and for them to be 180 degrees out of phase the path length A-D-B. must be an odd number of half wavelengths different from the length AB.

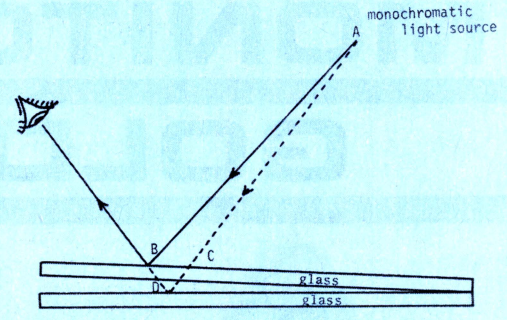


Figure 1. Reflection of light from different surfaces produces interference patterns.

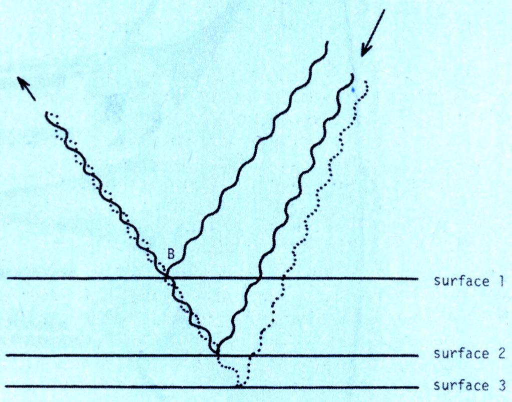


Figure 2. Phase relationships between light reflected from three surfaces.

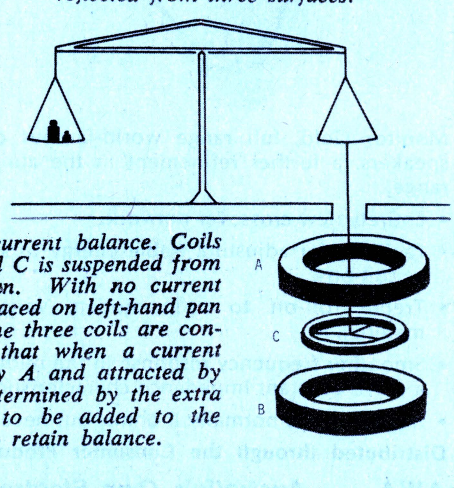
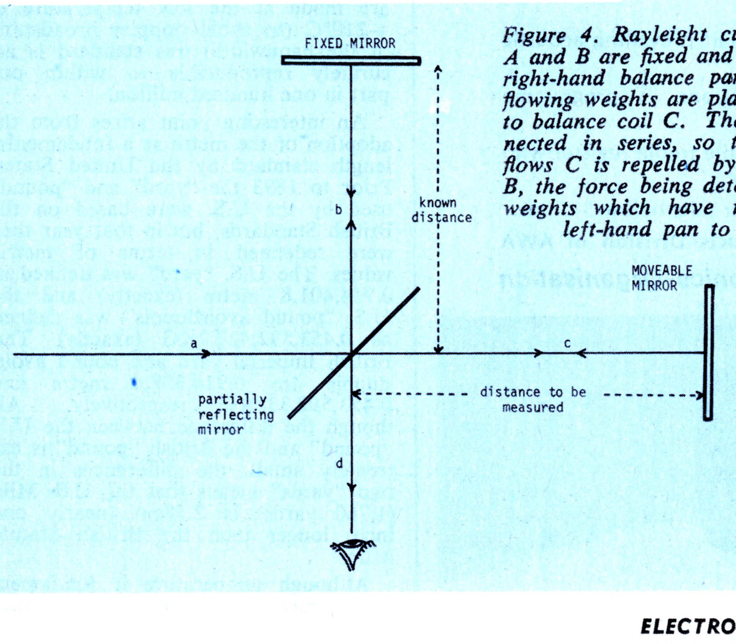


Figure 4. Rayleight current balance. Coils A and B are fixed and C is suspended from right-hand balance pan. With no current flowing weights are placed on left-hand pan to balance coil C. The three coils are connected in series, so that when a current flows C is repelled by A and attracted by B, the force being determined by the extra weights which have to be added to the left-hand pan to retain balance.



LEFT: Figure 3. General principle of Michelson Interferometer. Parallel light beam (a) strikes partially reflecting mirror and part is transmitted to movable mirror (c). The two light beams return via (b) and (c) and are respectively transmitted and reflected by the partially reflecting mirror along (d) to the observer, who counts the fringes as the mirror moves along distance to be measured.

This is illustrated in figure 2 where the light reflected from surface 2 is in phase (solid line) with the light reflected from surface 1 at B, but the light reflected from surface 3 (dotted line) is fully out of phase with the light reflected from surface 1 at B. The separation of the two glass plates (hence the thickness of the paper separating the plates) may be determined by viewing the reflected light along the length of the plates from the point where they touch to the point where they are separated by the paper, and the number of "fringes" (alternate dark and bright lines) seen represents the number of wavelengths separating the glass plates where the paper is inserted. If the wavelength of the light is known the thickness of the paper may be readily determined. As the wavelength of visible light is extremely small (for sodium light it is approximately 0.0006 millimetres) many fringes have to be counted to obtain even small measurements, but the accuracy of such measurements is correspondingly great. The Michelson Interferometer which utilises this principle is shown in figure 3.

By interference methods using common monochromatic light sources lengths up to about 20cm may be easily measured, and automated fringe-counting equipment has been developed to ease the task of counting. As normal monochromatic sources are not truly monochromatic, but are spread over a narrow range of wavelengths, distances greater than 20cm are hard to measure, as the interference patterns from the slightly different wavelengths tend to merge together after a few million fringes. Because laser beams are spread over an extremely narrow range of wavelengths such light may be used to determine much longer distances, and the U.S. National Bureau of Standards in 1963 succeeded in directly measuring a distance of 200 metres by counting fringes of the light obtained from a Helium-Neon Laser.

Due to reproducibility and accuracy of measurement of the wavelengths of light the 11th General Conference redefined the metre as 1,650,763.73 times the wavelength of the orange light emitted by the krypton-86 atom. When measurements of this wavelength are made at the low temperature of −210°C (to avoid doppler broadening of the bandwidth) this standard is accurately reproducible to within one part in one hundred million.

An interesting point arises from the adoption of the metre as a fundamental length standard by the United States. Prior to 1893 the "yard" and "pound" used by the U.S. were based on the British Standards, but in that year they were redefined in terms of metric values. The U.S. "yard" was defined as 0.914,401,8 metre (exactly) and the U.S. "pound avoirdupois" was defined as 0.453,592,427,7KG (exactly). The British Imperial yard and pound avoirdupois are 0.914,398,4 metre and 0.453,592,338KG respectively. Although the difference between the U.S. "pound" and the British "pound" is extremely small, the differences in the two "yards" means that the U.S. Mile (1,760 yards) is 2.18cm (nearly one inch) longer than the British Statute Mile.

Although temperature is fundamentally a measure of energy its measure-

ment is important enough to warrant standardisation.

Temperature has always been difficult to measure for two reasons. The most obvious difficulty occurs in devising an accurate measuring device, and even the best modern methods of temperature measurement have accuracies not better than one part in ten thousand. The second difficulty occurs in obtaining accurately reproducible temperatures.

During the nineteenth century Lord Kelvin devised a scale of temperature in which the zero point is the point of zero thermal motion for an ideal gas. This occurs at 273.15°C below the freezing point of water. This temperature scale is known as the "Absolute Thermodynamic Scale of Temperature" or Absolute temperature and is expressed in Kelvins. (The word "degree" is now omitted from the absolute scale of temperature.) The Kelvin is equal in size to the degree in the Celsius scale, the difference being only in the zero reference point, for example 0K = −273.15°C, 273.15K = 0°C and 373.15K = 100°C.

During the 1920s the International Bureau of Weights and Measures attempted to devise a practical scale of temperatures, based on the Celsius and Absolute temperature scales, by defining a number of fixed reference points such as the boiling and freezing points of very pure substances. These values were expressed as temperatures in the Celsius scale which were related to the Absolute scale by a constant difference factor.

The 10th General Conference redefined the Absolute temperature scale with a single fixed point (known as the "triple point" of water) at 273.16K, which is only 0.01°C different from the freezing point of water. This fixed point can be reproduced with an accuracy of about one part per million, which is far more accurate than either the freezing or boiling points of water.

There are six defining points in the International Practical Temperature scale (agreed on in 1948), and these are all expressed in °C. They are, (1) the boiling point of oxygen (−182.97), (2) the triple point of water (0.01), (3) the boiling point of water (100.0), (4) the boiling point of sulphur (444.6), (5) the freezing point of silver (960.8) and (6) the freezing point of gold (1,063.0). These measurements are to be carried out under certain specified conditions, as, for example, the boiling point of water varies with atmospheric pressure.

Measurements of temperatures outside this range — for extension of the temperature scale — is difficult, but temperatures down to 14K may be measured with reasonable accuracy by resistance thermometers and this extension may be the next adopted. For temperatures between about 1000°C and 4000°C optical pyrometers are used, and for temperatures above this spectroscopic methods are employed, but accuracies are limited.

In the realm of measurement, length, mass, time and temperature are considered as fundamental and other quantities are directly obtainable by the use of fundamental laws of Physics. Because of their importance, however, two other quantities have been defined. These are the Ampere for electric current and the Candela for light intensity.

The Ampere may be determined from the magnetic field produced by a current. This magnetic field exerts a force on a nearby magnetic field and the force may be determined by reference to length, mass and time standards. The definition of the Ampere recommended by the International Bureau in 1946 and adopted at the 9th General Conference in 1948 is the constant current which, when flowing through two parallel conductors one metre apart, exerts a force of two ten-millionths of a newton (the M.K.S. unit of force) for each metre of length of the conductors.

Although the Ampere is defined in terms of the force between parallel currents, in practice the conductors are wound in the form of coils of many thousands of turns and the force measured by comparison with weight-forces on a beam balance. An example of such a device is the Rayleigh Current Balance shown in figure 4.

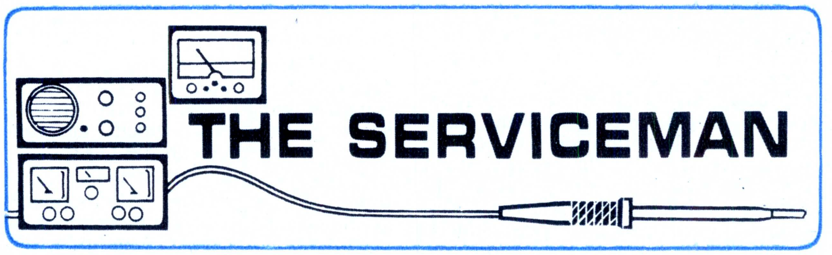
The Candela, as it is a measurement of energy, may be directly expressed in terms of mass, length and time, but as readily accessible references are required it is more convenient to define it in a simpler form. The earliest "standard" form of a unit of light intensity is the Candle, defined in Britain as "the amount of light emitted by a sperm candle seven-eighths inch in diameter and burning 120 grains per hour."

As may be appreciated the Candle defined in terms of real candles is not very accurate, and in 1909 Britain, France and the U.S.A. agreed to a standard defined in terms of carbon-filament lamps. But even this was not good as the light intensity is dependent on age and other operating conditions. In 1948 the 9th General Conference adopted the Candela, defined as one-sixtieth of the intensity of light emitted from one square centimetre of a fully radiating body at the temperature of freezing platinum (1769°C). This value is very close to the "Candle" of the old British system.

In practice the radiation from a perfect radiator is not easy to use, so it is initially used to calibrate filament lamp substitute-standards which are used for more routine calibrations.

If only standards of length, mass, time and temperature were obtainable at Standards Bureaus throughout the world the calibration of industrial and scientific instruments would be an extremely laborious task. For this reason many second-order standards such a standards of resistance, inductance and capacitance are kept so that equipment may be directly calibrated, or substitute standards compared for accuracy.

The second order standards are derived directly from the fundamental standards. For example the Volt is defined as the potential difference across a conductor which dissipates a power of one watt when the current flowing is one ampere. The resistance of this conductor is one ohm, thus the ohm is automatically defined. As the watt is directly related to the kilogram, metre, second and kelvin via its heating effect the second order standards may be determined.



"Sneaking up" on Intermittents

The law of "The Perversity of Inanimate Objects"—somewhat similar to Murphy's Law—may well be dismissed by the academics as mere superstition, but I'll bet none of them have ever tried to catch up with an intermittent fault in a piece of electronic equipment.

In the March issue the Editor suggested that fellow servicemen may like to contribute unusual service stories for inclusion in these columns. The first of these comes from J.C. of Merrylands, N.S.W. who seems to have evolved a method of "sneaking up" on intermittents under the pretence of fixing a completely different fault.

Here is the story as he tells it.

"The service call I am about to describe was really a continuation of one I had made to the same set several weeks previously, even though it didn't start out this way. On the previous service call the customer had complained about the sound section.

" 'Sometimes,' she said, 'I can't turn the volume down. It's much too loud and I'm afraid the neighbours will complain.'

"As you may have guessed, the whole crux of the matter was the customer's word 'sometimes.' It indicated an intermittent and, although I went through the motions of making a call, I wasn't really surprised when I could not fault the set in any way; nor was the customer, apparently. While assuring me that the sound was much too loud at times she also said that she felt quite sure that it would behave itself the moment I put my foot in the door.

"There must be a 'presence' about TV servicemen; something like the inexplicable 'difference' which allows a criminal to sense a plain clothes policeman no matter how carefully he tries to hide his identity. Only in this case it is the TV set which senses the serviceman. Thus no piece of equipment suffering from an intermittent will misbehave from the moment one puts one's foot inside the door until one has driven away around the corner.

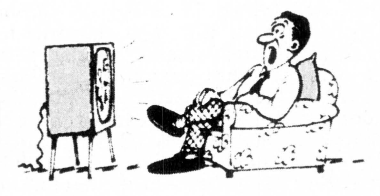
"There was little I could do in these circumstances, except try to find out all I could about the fault in preparation for the next time.

" 'Maybe the station was only winding up the sound on the advertisements,' I suggested.

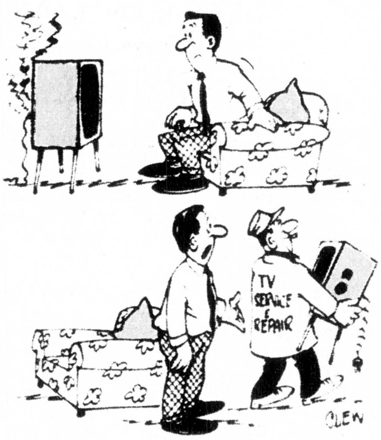
" 'I can't imagine they would turn it up that loud,' she replied. 'Besides, it doesn't only happen on the advertisements. Sometimes it goes for hours at a time.'

"Which seemed to settle that argument. All I could to was to advise her to contact me when it gave trouble again. Which was the last I heard of the problem until yesterday, so I had assumed that it had given no further trouble. And even yesterday's call seemed to involve something quite different, since the scribbled phone message said. 'No picture. Weak sound.'

"When I arrived at the customer's home there was no mention of the previous fault, so I went straight to the business of checking the 'no picture' fault. I turned the set on and waited for it to warm up. When it did it confirmed the customer's complaint; there was no picture, and there was only weak sound, although I noted that the sound still responded to the volume control. I also noted that there was still a raster on the screen, an important clue in any 'no picture' diagnosis.



I don't know why I bother switching it on!



Please be quick—I'll be lost without it!—("TV Times.")

"Loss of picture, while the raster remains, indicates that the horizontal deflection system and EHT supply — which represent a substantial proportion of the circuitry — is functioning normally, and that the fault will be somewhere in the signal path. If the sound is normal then the trouble will almost certainly be somewhere in the video section, not excluding the picture tube itself.

"If, on the other hand, the sound has failed completely, as well as the picture, the failure is most likely to be ahead of the video detector. This reasoning still leaves a substantial portion of the set to be investigated, but at least one does not waste time looking in the wrong places.

"In the present case the symptoms were not quite so clear cut, in that the sound was neither normal nor absent, but simply weak. I wonder if any readers can pick the likely section which would cause this fault?

"Fortunately I didn't have to have to indulge in any very deep reasoning to work it out: I had been through that exercise a long time ago with this particular make and model of set. I went straight to the last IF transformer, removed the can and snipped out the video detector diode. A quick check on the low ohms range of the voltmeter confirmed my suspicions; the diode read 'short circuit' in both directions.

"Previous experience has also shown that the most likely cause of this fault is a flashover inside the 6DX8 video amplifier, so I always make it a practice to replace this valve also. Failure to do this is inviting trouble in the form of call-back and loss of reputation.

"With everything back in place it was time to switch on. Can you imagine being crouched down behind a TV set, about 18in from the loudspeaker, with the sound turned full on? Well I was. I couldn't get to the volume control quickly enough. The only snag was it was already turned right down. So this was the fault I had been called to a month previously.

"The worst aspect of finding the fault was the fact that I had to leave the set playing with the sound flat out while I looked for it. At my suggestion the customer retired to another part of the house and closed the intervening doors. I simply did my best to ignore it.

"I first checked the leads and connections to the volume control, but these seemed too intact. Then I started probing around the wiring board carrying the sound section. It soon became evident that there was an intermittent somewhere on the board because, by springing it gently, I could cause the fault to come and go.

"The wiring boards in this set are made from brown insulating board on which is a pattern of terminals in the form of eyelets or hollow rivets. The components are mounted on the board and wired to the terminals. The board sits over a cut-out in the chassis and around the edge of this cut-out are metal tabs which are punched as part of the cut-out then bent upwards. These correspond with various earthy terminals on the board, and are soldered directly to them.

"Various earthy leads belonging to

components remote from the board, but associated with it electrically, are also connected to earth terminals on the board, these being specially provided for this purpose.

"This fault involved the earthy lead from the volume control. The lead was soldered to the terminal on the board all right, but close examination showed that the terminal had broken away from the chassis tab. Naturally, it didn't take much effort to rectify this situation, after which the sound was once more controllable.

"The customer admitted when we discussed the fault afterwards that the problem had occurred a few times in recent weeks, but she had not bothered to call me.

"From the trend of her remarks, I got the impression that she was afraid I would not believe her story of what was going on unless I was on the spot when the set played up. This impression was strengthened when she added that she was glad I had been able to hear it for myself.

"I was glad too, but I think I will add a roll of cotton wool — ears, for the use of — to my tool kit."

On quite another theme, I received a letter from Mr J. S., of Auckland, N.Z. His letter was prompted by the story in the issue of October last, in which a fellow serviceman related how he had been caught by a pair of new, but faulty, 6CM5s. Here is his letter.

Dear Sir,

"The Serviceman" in your October 1969 issue mentions a case of a TV serviceman being confronted with a "no picture" condition which led him to suspect a defective line output transformer. After substituting valves in the affected section and making various other unspecified checks, the repairman came to the conclusion that the L.O.P.T. must have been the cause of the trouble. In order to prove his suspicion he had to remove the old transformer and wire in a new one. Unfortunately, the new transformer did not improve matters and it was necessary to refit the old one.

As a practising serviceman I must confess to a feeling of incredulity after reading this. Even a non-serviceman reader must have wondered whether there could not have been some way of testing the suspected transformer "in situ," rather than being forced to adopt such a clumsy and time-consuming approach as replacing it. The account of this retold tale, originating with an employee of "one of the larger service organisations," leads me to wonder if all Australian servicemen are unaware of the existence of a piece of test equipment known as a flyback checker. This handy little gadget, which is about the size of a multimeter, can easily be carried in a serviceman's kit and has been in use in this country for the past six years.

Can it be that we in New Zealand are in possession of something unknown to our Australian counterparts?

Faults in line output transformers can be summarised as follows:

1. *Open circuit in winding.*
2. *Arcing, either between windings or from winding to core.*
3. *Shorted turns.*

Open circuits can be checked with an ohmmeter. Arcing can be spotted visually, as well as aurally and nasally too, sometimes! This leaves No. 3 which, without the use of a flyback checker, leaves no recourse but to substitute a new transformer. This statement applies only to "in the field" conditions for it is possible to use an oscilloscope to conduct what is known as a "ringing" test on the workshop bench.

As the person responsible for having this checker marketed in N.Z. I am in a position to know that it has been well received by the trade. Furthermore, the largest service organisation in the country has, more recently, marketed its own version. It has become a "must" in every serviceman's kit.

Yours faithfully,

J.S. (Auckland, N.Z.).

My first reaction, on reading this letter, was that my correspondent had missed the point of my story, which was more concerned with the coincidence of two faulty, but new, valves being selected in succession for a replacement test, than it was with methods of diagnosing faulty output transformers. However, I must agree that the situation was aggravated by the fact that the serriceman did not have a means to double check his diagnosis. On this basis, J. S. has a point; the frustrating situation which followed would have been avoided had the serviceman been able to double check his findings with something along the lines of a flyback tester.

Fair enough. But let us look at it another way. As far as the serviceman was concerned, the failure of the transformer was virtually established before he removed it. He replaced it, not "on spec.", but simply as a logical result of having concluded that it was faulty. What's more, his conclusion was perfectly valid on the basis of the observed symptoms; in other words, if the replacement valves had been good ones, and he had still observed all the other symptoms which he did observe, then he most certainly would have had a faulty transformer. In short. his test equipment — the replacement valves — let him down; not the first time a serviceman has been led up the garden path by a piece of faulty equipment.

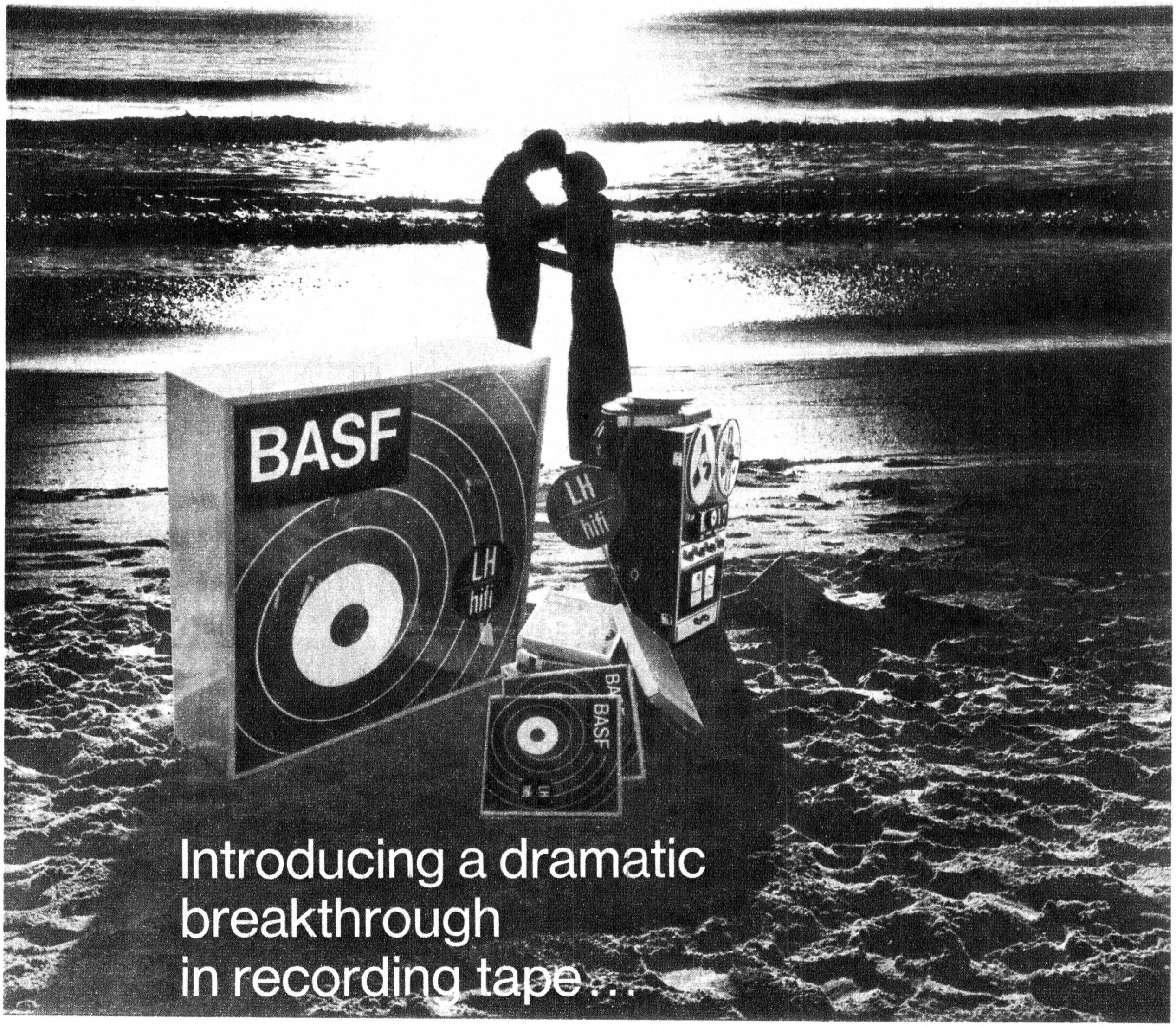
Which brings us quite naturally to the question; would he have found the real fault any sooner had he used the tester under discussion? He probably would have — IF everything had gone according to plan. For example, IF he had felt sufficient doubt about his diagnosis to bother making such a check. Or IF he had bothered to carry this particular piece of gear with him on that particular job.

The truth of the matter is that it simply is not a practical proposition for a serviceman to carry every piece of gear which — in theory at any rate — would prevent him from making such mistakes. Nor is it valid to argue that only one piece of gear would have been needed in this case. Such an argument is valid only with the wisdom of hind sight; a point which is very often overlooked in post mortem's of this kind.

Perhaps the fact that stories such as these are published is, in itself, misleading. What must be remembered is that they are published because they are the exceptional stories, the very opposite of the routine day-to-day jobs from which a serviceman makes his money. Sure, the fellow concerned was hopping mad about it at the time; but would he run out and buy this piece of test gear against the possibility of a similar situation occurring again? I thought it only fair to put this question to him.

It turned out that he was familiar with this device — or at least the existence of it — and even suggested the name of an Australian firm which was marketing one. He went on:

"I have often made the point that I would like to carry some extra pieces of equipment. However, company



BASF
low noise-high output.

BASF LH Magnetic Recording Tape is the world's only tape which combines ultra-low noise with a significant increase in output level across the entire audio spectrum. Other "low-noise" tapes simply do not have this increased output level.

By decreasing the basic tape noise, and increasing sensitivity BASF engineers have achieved a dramatic improvement in signal-to-noise ratio (Dynamic range) of as much as 8db over other quality tapes on the market. This means that recorders can reproduce sounds, from the faintest whisper to a booming crescendo, with more clarity, realism and less distortion than ever before.

BASF Low noise-High output magnetic recording tape — "the beginning of a new recording revolution."

MAURICE CHAPMAN & CO. PTY. LTD.,

BASF

276 Castlereagh Street,
Sydney, N.S.W., 2000.
Phone: 61 9881

MC01/FP

policy is that field servicemen need carry only a minimum of equipment suitable for the simpler faults. Faults which cannot be serviced with this equipment should be brought back to the shop where full facilities are available.

"And in fairness," he went on, "I must point out that the case in question was the first time in over seven years of TV servicing that I have been caught like that. I reckon I could claim that I can pick a faulty output transformer 999 times out of a thousand — even allowing for a pair of dud new valves.

"Is it worth carrying, say, $30 worth of gear to check one in a thousand?

"I can assure you the company wouldn't think so. With a large number of servicemen on the road they would logically have to equip each one with such a device. They just couldn't justify the outlay if each unit was used only once every few years. It would probably be worn out from being carried around in the truck before it could be used more than a few times."

I put it to him another way: "If your company gave you the O.K. to spend a significant amount of money on extra equipment, would this device be among the first you would buy?"

"No, by gee it wouldn't." he replied. "I'm not sure what I would buy first, but it wouldn't be that.

"Mind you," he added, "Even my multimeter does not get that much use. I suppose I would take it into a customer's home about once in every two days. For the rest I rely on what I can see on the screen and on experience."

To get another slant on the situation I tried another colleague; one who is in business for himself, is essentially a one man show, has been going since the start of TV, and who seems to prosper without making exhorbitant charge or resorting to snide tactics.

"At one time," he said, "I might have welcomed such a device but, with experience. one soon acquires what is almost a sixth sense about these things. So much so, that I don't regard it as a problem these days. In the main, there is only one brand of EHT transformer which gives any real trouble. When I encounter a set with an EHT failure, and using one of these transformers, I would suspect it immediately I had disposed of the more obvious checks, such as replacing the appropriate valves and confirming that there is drive from the line oscillator stage.

"On the other hand, there is a brand of EHT transformer which I honestly cannot remember ever having had to replace. In a similar situation involving a set with this transformer in it, I would not suspect the transformer until all other possibilities had been examined.

"In addition, most transformers give some clue when they fail. For example, the unreliable transformer previously mentioned usually overheats badly, About one minute's operation makes it too hot to touch.

"As far as I'm concerned I would not consider buying any apparatus for checking EHT transformers. In fact, the only instrument I carry on field servicing is a VTVM. That, plus essential tools and replacement components, is all that I find I need."

As far as I can determine, the foregoing appears to be a fair summary of the attitude of most servicemen. Whether working as a one man organisation or as part of a large service company they make their money from the routine type of fault which can be rectified in the customer's home and which represents about 95 per cent of their work. The remainder are the difficult ones which are normally returned to the workshop for more intensive examination.

In the field the serviceman works with a minimum of equipment and a maximum of experience. And make no mistake about, experience counts most in this situation. To quote my second colleague again. "The less you know, the more equipment you need."

On the bench, where the hard ones accumulate, it is a different matter. Experience counts here too, but needs to be backed by good technical training and, with in reason, adequate equipment.

This system — fixing the easy ones in the field with a minimum of equipment and the hard ones in the workshop — works very well in practice. The majority of sets are repaired with minimum cost to the customer and without the set leaving the customer's home. (Customers don't like their sets being taken away). What's more, it achieves this with a minimum of capital outlay on equipment and with a minimum of this equipment out in the field where, inevitably, deterioration will be high due to handling, transport, etc.

As I say, the system works well. The only minor snag is that, once in a while, one gets caught. What looks like a simple fault, capable of being fixed on the spot, turns out to be a difficult one that should have been returned to the shop. Unfortunately, by the time one realises this, one is so committed in terms of time already spent that there is a strong temptation to press on and try to justify it by at least getting the set going on the spot.

Which is exactly what happened to my colleague with the two supposedly good 6CM5s. It was no reflection on either the serviceman, the firm for which he worked, or the broad concept of service as it is generally practised.

It was just one of those things.

Following my remarks in the December issue about the compatability of TV sets from one country to another country, I received the letter reproduced herewith. It appears to be from a European migrant and, while I am not sure, I gather he is taking me to task a little because I sounded a note of caution is this regard. Apparently, he feels that the fact that he bought a set into the country and is receiving all the local channels on it, is convincing proof that there is no problem.

Dear Sir,

In the December issue, "The Serviceman" discussed the compatability of foreign TV sets. Having just visited Europe, I bought a small all transistor TV set while there. It was built in Japan for German standards, which include both UHF and VHF channels.

This set has a 12-channel switch for VHF and a separate switch giving about 50 channel variations on UHF. Since Australia has no UHF transmissions an Australian set will have only limited usefulness in Europe.

On my arrival in Australia I found that all four channels in Melbourne were received perfectly — both sound and picture. Incidentally, The Serviceman was right about the Customs duty, I had to pay $94 to bring it in. Price in Germany—$75.

Yours faithfully,
R.F. (St. Kilda, Vic.).

All I can say is, "You were lucky, mate." But I wonder if you realise that there are several channels in Australia which your set cannot receive. In Melbourne, or most of the other capital cities, you can cope. Your set will be "near enough" for channels 0 and 2, "spot on" for channels 6, 7, 8 and 9, and "near enough" for 10 and 11. But what of channels 3, 4, 5, and 5A? There is a complete gap in the European channel system over this range. If you happen to move out into the country area, many of which are served by two of these channels and nothing else, your set would be virtually useless.

So, to anyone aspiring to bring back sets from overseas, I would repeat my warning. Be very careful and very sure that you have checked all the possibilities. Otherwise you could pay out a lot of money for something of limited usefulness. Oh, and don't forget some spare parts while your about it. You might find it hard to get your European set serviced otherwise, should something vital fail.

MAGRATH'S

VEROBOARD FULLY PIERCED copper clad

Part No.	No. of Strips	Size	Pin Size	Price
2/7003	16 way	17.9" x 3.4"	.052"	$1.64 each
4/1001	21 way	18" x 4.8"	.052"	$2.00 each
6/7006	24 way	17.9" x 5"	.052"	$2.25 each
41/1501	16 way	17" x 2.55	.052"	$1.16 each
44/1505	24 way	17" x 3.75"	.052"	$1.60 each
101/231	27 way	17" x 4.371"	.052"	$2.00 each
122	34 way	17.9" x 3.75"	.040"	$1.86 each

VEROBOARD Copper clad each side

Part No.	No. of Strips	Size	Pin Size	Price
1311	39 way	8.1" x 8.4"	.052"	$3.51 each

VEROBOARD PLUG-IN copper clad

Part No.	No. of Strips	Size	Pin Size	Price
202/7011	16 way	5.1" x 3.4"	.052"	$1.04 each
241/2502	16 way	5" x 2.55"	.052"	$0.93 each
243/2504	24 way	8" x 3.75"	.052"	$1.60 each
245/2506	24 way	3.75" x 3.75"	.052"	$1.16 each
281/271	23 way	3.7" x 3.591"	.052"	$1.13 each
304	22 way	3.7" x 2.5"	.040"	$1.04 each

VEROBOARD PLAIN

Part No.	No. of Strips	Size	Size Pin	Price
402/7022	16 way	17.9" x 3.4"	.052"	$1.16 each
403/4001	21 way	18.0" x 4.8"	.052"	$1.34 each
441/4501	16 way	17" x 2.5"	.052"	$0.78 each
442/4505	24 way	17" x 3.75"	.052"	$1.00 each
522	34 way	17.9" x 3.75"	.040"	$1.16 each

VERO-EDGE Connectors available

To Suit Boards	303, 44/1505 243/2504 245/2506	$2.44
To Suit Boards	202/7011 2/7003	$3.30
To Suit Boards	281/271	$2.96

TERMINAL PINS

2140/3073 To fit a 0.052" (1.32 mm). diam. hole 85c per 100

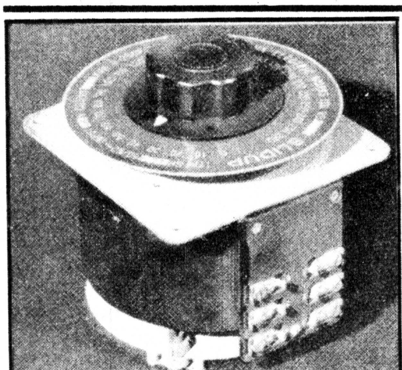
2142 To fit a 0.0375 (0.94 mm). diam. hole 45c per 100.

2141 To fit a 0.052" (1.32 mm). diam. hole 85c per 100.

POST FREE 15% Sales Tax Extra

PLAYMASTER No. 128 STEREO AMPLIFIER (Electronics Australia, January, 1970)	$ 99.00
COMMUNICATIONS RECEIVER (Electronics Australia, January, 1970)	$188.00
VOLUME COMPRESSOR (Electronics Australia, February, 1970)	$ 19.50
DIGITAL FREQUENCY METER (Electronics Australia, March, 1970)	$246.00
RADIO CONTROL RECEIVER (Electronics Australia, February, 1970)	$ 19.20
MULLARD 10-10 VALVE AMPLIFIER (Electronics Australia, February, 1970)	$108.00
PLAYMASTER 106—STEREO AMP AND TUNER (Electronics Australia, December, 1963)	$104.00
PLAYMASTER 116 40 WATT GUITAR AMPLIFIER (Electronics Australia, June, 1967)	$ 85.00
PLAYMASTER 123 PROGRAM SOURCE TUNER (Electronics Australia, August, 1968)	$100.00
PLAYMASTER 117 60 WATT GUITAR AMPLIFIER (Electronics Australia, July, 1967)	$ 88.00
PLAYMASTER 118 STEREO AMPLIFIER (Electronics Australia, July, 1967)	$ 86.00
PLAYMASTER 115 SOLID STATE STEREO AMP (Electronics Australia, April, 1967)	$104.00
PLAYMASTER 120 HYBRID CONTROL UNIT (Electronics Australia, February, 1968)	$ 49.00
VARI-TACH MOTOR SPEED CONTROL (Electronics Australia, March, 1966)	$ 24.00
TRAIN CONTROLLER WITH SIMULATED INERTIA. Plain panel.	$ 14.75
Printed panel (Electronics Australia, March, 1967)	$ 17.00
LOW COST POWER SUPPLY (Electronics Australia, January, 1968)	$ 28.50
PLAYMASTER 124 STEREOGRAM (Electronics Australia, May, 1969)	$ 76.00
MUSICOLOUR (Electronics Australia, October, 1969)	$ 49.00
PLAYMASTER 127 INTEGRATED CONTROL UNIT (Electronics Australia, November, 1969)	$ 56.00
10 PLUS 10 STEREO AMPLIFIER WITH OVERLOAD PROTECTION (Electronics Australia, April, 1969)	$ 78.00

Ask for kit quotation for any other circuit of your choice or separate components. The above prices include sales tax. Freight free within Australia.



VOLTAC Variable Autotransformers

TYPE	IN V	OUT V	Current	CAP VA	PRICE Sales Tax extra
P1 Panel Mounting	230	0.260	0.5 Amps	100	$9.75
BP3 Panel Mounting	230	0.260	1.5 Amps	300	$14.60
BP5 Panel Mounting	230	0.260	2.5 Amps	500	$17.55
SB5 Bench Mounting	230	0.260	5.0 Amps	1000	$24.95
SB10 Bench Mounting	230	0.260	10.0 Amps	2000	$47.15
B15 Bench Mounting	230	0.260	15.0 Amps	3000	$61.45
B25 Bench Mounting	230	0.260	25.0 Amps	5000	$108.90

15 per cent Sales Tax where applicable. FREIGHT EXTRA!
The above also available in 3-phase combinations. Prices on application.

COME TO MAGRATHS—WE'VE GOT IT!

J. H. MAGRATH & CO. PTY. LTD.
208 LT. LONSDALE STREET, MELBOURNE, VICTORIA, PHONE 663 3731

ALTERNATIVE FILTERS FOR 122, 123 PROGRAM SOURCES

Disappearance from the local market of certain types of ceramic filter has threatened the viability of two of our popular designs, the Playmaster 122 and 123 program sources. Fortunately, suitable substitutes are available.

When we originally developed and described the two program sources (or radio tuners) we had a choice of two brands for the simpler filters: "National" imported by STC and "Murata" imported by IRH.

After some consideration, we settled for two of type D455K1 and one of type D455K3; both imported by STC. These were of different bandwidths and with a tolerance on centre frequency of ±1KHz. Subsequently we were notified that only wider tolerance units would be available in future; the type numbers of these would be D455K2 and D455K4 respectively, and the tolerance ±2KHz. However, the importers agreed to make available matched sets of three filters for use in these tuners; this arrangement prove to be satisfactory, although somewhat confusing for readers at the time.

Then, a few months back, we learned that no more D455K2 and D455K4 filters would be imported. Fortunately, good stocks were already available on dealer's shelves and there was no immediate need to consider possible alternatives.

In recent weeks, however, there has been an accelerated demand for the particular filters and, just before going to press, stocks were virtually exhausted.

Fortunately, the alternative Murata range of filters is still in good supply, including types which will replace those originally specified. There are electrical and mechanical differences but substitution is nevertheless possible.

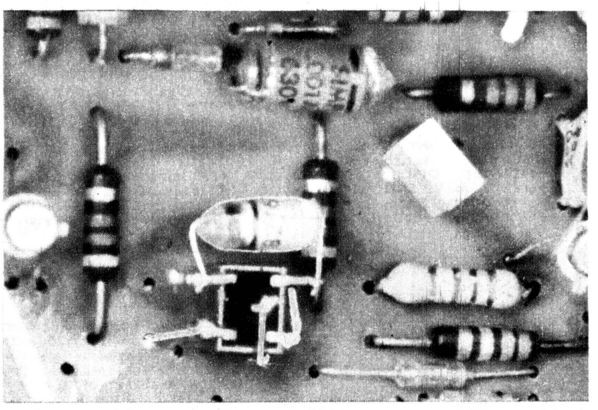
The D455K3 used between the AGC amplifier and the AGC rectifiers may be replaced with its electrically similar Murata counterpart, type SFB-455A. The physical configuration is slightly different and the necessary mounting modifications will be dealt with later.

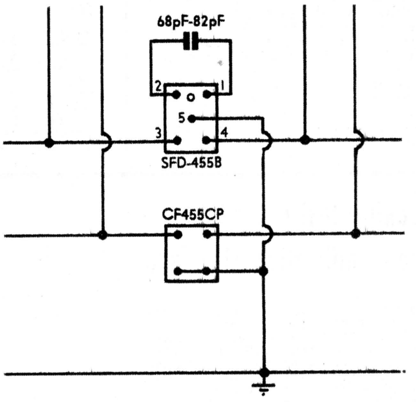
The two coupled D455K1 filters posed a problem at first but we found that they could be replaced by a single Murata SFD-455B filter with little change in the overall response curve. This latter filter is, in fact, made up of two SFB-455A filters mounted within the same case. It is assumed that external capacitive coupling will be provided between the two sections, affording a degree of control over the bandwidth.

The value of the coupling capacitor may be adjusted experimentally but we found that a value between 68pF and 82pF gave a bandpass characteristic very close to the original.

(The fact that the SFD-455B filter is two SFB-455A filters in the one case is itself interesting. In the event of the latter filters not being available at any time, one half of an SFD-455B filter can be used instead, the unwanted leads being clipped off or bent up out of the way.)

A close-up of the modified board showing the SFD-455B filter upside down at lower left and the SFB-455A, angled at 45 degrees, upper right.





This diagram, which can be related to the original circuit, shows the revised connections to the SFD-455B filter. The Murata CF-455P wideband filter is still readily available.

As there are still many printed boards on dealers' shelves, we set out to see what could be done to fit the Murata filters in the spaces provided for the original filters. Happily enough, the problems are easily overcome and this is how we went about it.

The easiest one to deal with is the single filter in the AGC circuit. Physically, the National and Murata filters for this position are different. However, they each have three pins, i.e., input and output, the third and offset centre pin being connected to earth in each case. The input and output pins on the Murata filter are a little closer together than the National, while the Murata centre pin is not offset as much as the National.

The neatest way to mount the new filter is to use a jeweller's file and file the holes in the board, corresponding to the input and output pins, such that the pins may be pushed through the holes. This leaves the offset of the centre pin to be adjusted. Bend the pin first outward and at a right angle to the case. Then bend the pin at a right angle again so that it will enter the hole. The pins are then soldered to the copper on the board in the usual way. Some of the copper will be lost in filing and care should be taken to make sure that a good joint is made between the available copper and the pins.

An alternative but less neat approach involves turning the filter upside down against the board in the appropriate position. Thin tinned copper leads are soldered in the holes on the board and brought up to the respective pins which are bent over to meet the leads and soldered.

In the other case, where the original pair of filters is to be replaced with a Murata SFD-455B, it is not possible to alter the board to solder the filter directly to the copper points. Here, the problem is best met simply by doing just what we have described as the alternative for the single filter. The new filter is mounted upside down on the board where the original filters were located. Tinned copper connecting leads are used as described earlier to connect the input, output and earth pins. The top coupling capacitor, with short leads, is soldered across the remaining two pins, nearest the dot on the case.

The foregoing description will be clearer when the close-up picture of the relevant part of the board is inspected.

Although we have shown how to mount the new filters on the boards currently available, we propose to modify the boards for future use and, in due course, some manufacturers may see fit to produce a modified board. Meanwhile, there is no reason why the above method should not be adopted.

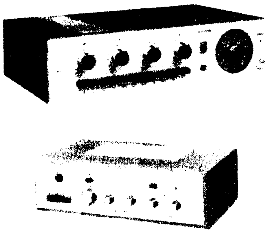
We have drawn the slightly modified circuit for the coupled pair and this simply shows the two elements in one enclosure, with the addition of the top coupling capacitor. We have shown the value as being either 68pF or 82pF. The larger value of capacitance simply broadens the selectivity a little and is the one we prefer as the selectivity approximates the degree of selectivity which we obtained in the original circuit. The type of capacitor which we prefer is the readily available Styroseal, which is stable, small and light in weight.

Genuine Hi-Fi Record-Playing Equipment can Only be Purchased at the

RECORDED MUSIC SALON

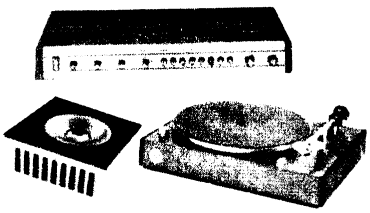
We are Sole Agents for Australia for World's Best Hi-Fi Materials. They are as follows: Armstrong-England, Jordan Watts-England, Rogers-England, Schaub-Lorenz-Germany, ERA-France, Empire-U.S.A., Harman Kardon-U.S.A.

THIS MONTH'S SPECIAL PACKAGE DEALS TO MARK THE OPENING OF OUR NEW SHOWROOMS AT 11 COLLINS STREET, MELBOURNE:



UNIT 1—

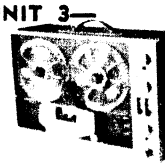
Armstrong 426 tuner/amplifier, power output, continuous sine wave: 25 watts per channel, 8 ohms. Power Bandwidth: 20-25,000 Hz. Frequency Response: 20-20,000 Hz plus/minus 1 dB. Harmonic distortion: less than 0.5% at 1 kHz measured at 25 watts output plus/minus 1dB. Complete with BSR Model MA 70 turntable, manual/automatic, including Empire 808 cartridge, frequency response: 10-20,000 Hz with 30dB of stereo separation, Plus 2 Leak Mini Sandwich loudspeakers. **Total Price: $549.00.** The same with Rogers Ravenbrook stereo amplifier, power output: 15 + 15 watts R.M.S., into 8 ohms. 1 kHz (Both channels driven simultaneously.) Total Harmonic Distortion: Less than 0.1% at 10 watts into 15 ohms. 1kHz. Input Sensitivities: DISC: 2/4/25/50 m/V. 47K impedance. Signal to Noise: Disc input: 2 m/V. Short circuit up to 10K load. Better than −53 dB relative to 10 watts. Radio Input: Volume control, maximum—better than −65 dB, minimum—better than −80 dB, relative to 10 watts. **Total Price: $429.**



UNIT 2—

Schaub-Lorenz Model 4000 stereo tuner/amplifier, 25 watts per channel, Transformerless push-pull output stages with a continuous sine wave power of 2 x 16 watts. Harmonic Distortion less than 1%. Power Bandwidth: 20 Hz-20kHz. Broadcast, short wave, long wave, ultra short wave (FM). Fully transistorised. Complete with 2 Jordan Watts loudspeakers with a special input of 5 ohms impedance, complete with ERA Mk III, the most brilliantly designed turntable, made in France. The pick-up arm tracks as low as 1/10th of a gram. Including the Empire 888VE cartridge, frequency response 6 — 32k Hz with a stereo separateion of 30 dB. high compliance of 30 x 10-6 cm/dyne with an unusually low tip mass for excellent tracking at minimum weights. **Total Price: $608.00.**

UNIT 3—



Ampex Model 2163 stereo tape recorder, complete with two Harman Kardon HK 40 loudspeakers, response from 30-20,000 Hz, handles over 50 watts music power, 4 ohms impedance. Total retail price: $925.00 **Your Total Price: $800.00.**

UNIT 4—

Leak Stereo 30 amplifier, frequency response: plus/minus 1 dB 30 Hz to 20 kHz. Total Harmonic Distortion: 0.1% for 8 watts output per channel into a 15 ohm load. Power Output: 10 watts per channel into a 15 ohm load. 15 watts per channel into a 4 ohm load. (Both figures are 1HFM music rating.). Complete with 2 Goodman's 10in Twinaxiom loudspeakers, Dual 1212 turntable and Empire 808 cartridge, frequency response 10-20,000 Hz with 30 dB of stereo separation. Compliance is 8 x 10-6 cm/dyne, and the 7 gram cartridge employs a .7 mil conical diamond stylus tracking at 15 degrees. **Total Price: $329.00**

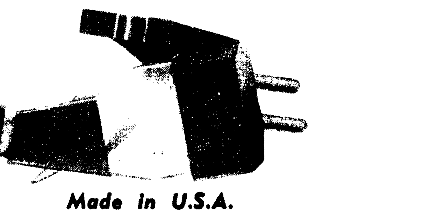
UNIT 5—

Sansui 222 stereo amplifier, total music power output of 46 watts, power bandwidth 20-20,000 Hz, plus 2 Wharfedale Super loudspeakers, BSR Model MA 70 automatic/manual turntable and Empire 808E cartridge, frequency response: 10-25,000 Hz compliance of 12 x 10-6 cm/dyne. **Total Price: $245.00**

UNIT 6—

2 Leak Sandwich Mk II loudspeakers, cross over frequency: 900 Hz via sophisticated 6 element filter, impedance: 15 ohms nominally, PE 34 belt-driven turntable, with Empire 808 cartridge, frequency response 10-20,000 Hz with 30 dB of stereo separation, compliance: 8 x 10-6 cm/dyne.
Total Price: $300.00, With a Monarch Model SA 500 amplifier, **$380.00.**

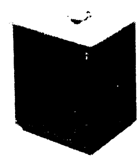
The cartridge designed for checking test records
The new Empire 1000ZE—stereo calibration standard



Made in U.S.A.

Each 1000 ZE cartridge is individually calibrated to have a flat frequency response within plus or minus 1 DB from 20,20,000 Hz. There are no electrical or mechanical resonant peaks and total IM distortion at the standard 3.54 cm/sec groove velocity does not exceed .05 per cent at any frequency within the full spectrum. Stereo separation is better than 35 DB at 1 KC and remains at least 25 DB or better all the way out to 20,000 Hz. Overall frequency response 4 to 40,000 Hz. Output voltage 5 mv per channel. The calibration standard 1000ZE stereo cartridge was designed to provide professional users such as recording studios, radio stations, scientific and engineering laboratories, as well as serious audio-philes with the ideal standard for record playback evaluation. The 1000ZE tracks effectively at stylus forces as low as 0.1 gram and never subjects the disc, whether it is vinyl pressing or master lacquer, to any visible wear or groove deformation. In high performance pickup arms (for example the Empire 990) operation stylus pressures below 1 gram may be used with most recordings. The Empire cartridge is the finest stereo-mono cartridge ever developed. Assembled under carefully controlled conditions, the Empire cartridge is inspected at each phase of its manufacture. Experienced, skilled American workmanship and design are responsible for its superior performance. The stereo performance of the Empire cartridge sets a new standard in listening quality The Empire cartridge gives new meaning to the word "compatible." For, in playing monophonic records, it outperforms the finest monophonic cartridges previously used.

Price in U.S.A.: $99.95. Our price in Australia: $100.00.



THE CAVALIER 2000

At just 16½in high, and less than 1.4 cubic feet overall, this is the most remarkable "budget" speaker system you'll ever hear. When "High Fidelity" magazine first heard the 10in high-compliance woofer and mid-range tweeter high-power radiator that make up this Cavalier system, their verdict was: "Splendid . . . one of the cleanest and most transparent (speaker systems) available . . . The midbrass region is outstandingly clean and uncoloured."
Frequency response: 35-18,000 Hz. Power Handling Capacity: 75 watts, undistorted. Nominal Impedance: 8 ohms.

THE MODEL 8200 IMPERIAL GRENADIER

Now the thrilling Grenadier sound and phenomenal, stereo separation can be captured in customised wall units, or your existing cabinets and consoles.
Frequency response: 30-20,000 cps, Nominal impedance: 8 ohms. Power handling capacity: Music power, maximum undistorted 100 watts, Sine Wave Power: 25-450 cps . . . 60 watts 450-5000 cps . . 40 watts. 5000-20,000 cps . . . 20 watts.

We attend with special care to Mail Orders and Wholesale Enquiries

RECORDED MUSIC SALON

23 COLLINS STREET, MELBOURNE 3000.

C. PINCZEWSKI **TRUE FIDELITY** **Telephone 63-6257**

A READER BUILT IT

Triac Test Added To Tester

The Transistor Test Set described in the August 1968 issue had no provision for testing Triacs, this being regarded as a somewhat specialised requirement at the time. However, a reader who needed this facility described how he added it to the original instrument.

We needed a simple way of checking Triacs, which we use in temperature controllers, speed controllers etc. Since we also had some need for a transistor checker, we decided to modify the design described in August, 1968, "Electronics Australia."

To obtain an extra position for "Triac" on the Device Selector switch, the two transistor positions (NPN, PNP) were combined and selected on a second 2 position, 6 pole switch. This is a fairly straightforward operation.

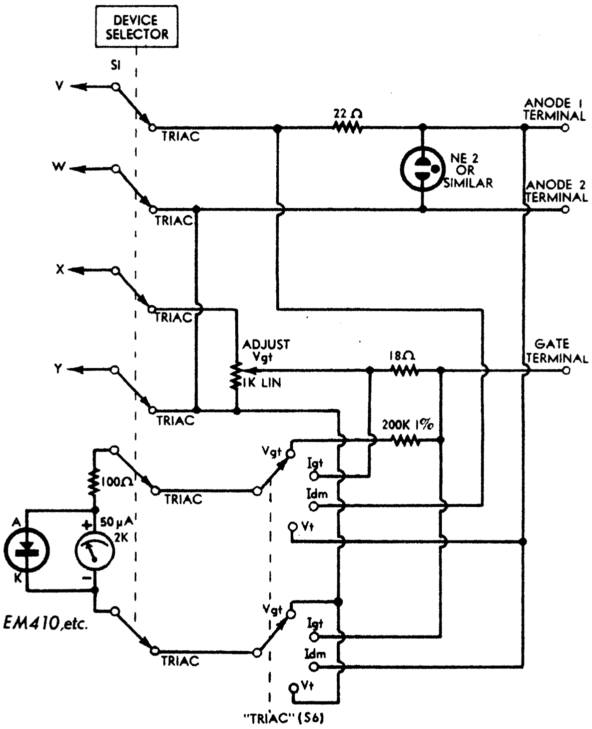
The other positions of the Device Selector switch were moved around one place and the last position was used to select the Triac tests. The circuit enclosed was used to wire up the Triac tests, the remainder of the wiring remaining as shown in the original article. A list of the tests, conditions and conclusions is appended.

Testing of silicon controlled rectifiers is also possible, provided they have a breakdown voltage greater than 200 volts. The significance of the measured parameters changes however.

Mechanical modifications we made included the use of a larger meter which we had on hand, fitted into a larger sloping front case. However, there should be enough room in the standard case to add the Triac test section if the front panel layout is changed to incorporate two extra switches (one for NPN/PNP selection, one for Triac testing functions), three Triac terminals and the test neon.

(Submitted by: Mr D. R. Leonard, Department of Biochemistry, University of Sydney.)

The circuit shows the additions necessary to the original circuit to enable it to test Triacs. Only one position of S1 is shown, the other positions will be found in the original circuit. S6 is a new 2-pole, 4 position switch to control the testing functions when S1 is on "Triac." This circuit should be studied in conjunction with the one for the original test set. (Page 37, August, 1968, issue.)



CIRCUIT FOR "TRIAC" SECTION OF TRANSISTOR TEST SET

DEVICE	TEST, CONDITIONS	COMMENTS
TRIACS May be used for SCR s. See text	**Vgt** (Vdx = 200V) D.C. Gate Trigger Voltage 10 Volt Range	Measured by adjusting Vgt from zero until indicator neon goes out. Normally Vgt well below 10V. FAILURE OF NEON TO EXTINGUISH INDICATES OPEN CIRCUIT **OR** TRIAC WITH INBUILT "DIAC."
	Igt (at Vgt found above neon off) D.C. Gate Trigger Current 20mA Range	Normally less than 20mA. Zero indicates Gate OPEN CIRCUIT. F.S.D. indicates gate SHORT CIRCUIT.
	Idm (Vdx = 200V) (neon on, Vgt = 0) Off state voltage 5mA range	Normally less than 1 mA. F.S.D. = A1/A2 SHORT.
	Vt (neon off) On state voltage 10 Volt Range	Normally 0.5 — 2 Volts. F.S.D. = A1/A2 OPEN CIRCUIT. Zero = A1/A2 SHORT CIRCUIT.

This table, showing the various tests and results for Triacs, is designed to coincide with the table in the original article. It may be added below it or in any other convenient place.

We started a revolution.

We introduced AMPEX Videotape* recording to:-

- **AIRLINES**
- **BANKS**
- **GOVERNMENT DEPARTMENTS**
- **INDUSTRY**
- **MINING COMPANIES**
- **RESEARCH LABORATORIES**
- **SCHOOLS**
- **SPORTING ORGANIZATIONS**
- **UNIVERSITIES**

A personnel training segment in progress.
Photograph by courtesy of the ANZ Bank, Melbourne.

One of the world's most dramatic revolutions in commerce, education and industry was started by the AMPEX CORPORATION several years ago.

AMPEX, the originators of sound recording, pioneered *video recording* — the recording of motion pictures and sound on magnetic tape, *for instant replay.*

Today portable AMPEX Videotape* recorders are used in offices and factories throughout the world as profitable training and research aids.

Continuing AMPEX development maintains AMPEX leadership in design and performance.

*Videotape AMPEX TRADEMARK

Simon Gray Pty. Ltd.,
28 Elizabeth St., Melbourne, 3000.

Please send me further information on AMPEX portable Videotape Recorders.

NAME ....

ADDRESS ....

COMPANY .... **POSTCODE** ....

Australian National Distributors:

Simon Gray Pty. Ltd.

Head Office: 28 Elizabeth St., Melbourne, Vic. Tel. 63 8101*
Sydney Office: 22 Ridge St., North Sydney, N.S.W. 929 6816
Canberra Office: 31-33 London Circuit, Canberra City, A.C.T. Tel. 49 6050

SALES AND SERVICE IN ALL CAPITAL CITIES

N.T.: Pfitzner's Music House, Smith Street, Darwin. Tel. 3801
Q'land: Sydney G. Hughes, 154-158 Arthur St., New Farm, Brisbane. 58 1422
S.A.: Eilco Sales Pty. Ltd., 7-9 Osmond Terrace, Norwood, S.A. Tel. 63 4844
Tas.: K. W. McCulloch Pty. Ltd., 57 George Street, Launceston. Tel. 2 5322
W.A.: Athol M. Hill, 613-615 Wellington Street, Perth. Tel. 21 7861

A READER BUILT IT . . . continued

High Performance Amplifier

With the introduction of low cost, high performance monolithic linear amplifiers into Australia it is possible to design audio equipment around them having high orders of performance. An amplifier employing these principles is described in this article.

An important point about this amplifier is that, because of the large open loop gain (approx. 10^5) and thus the large amount of negative feedback employed, any mismatch in the output transistor pair is immaterial. In fact, to minimise cost in this design a silicon NPN transistor is used with a germanium PNP transistor of similar output rating, each being relatively inexpensive.

Because of the large degree of feedback and good supply rejection of the integrated circuit a simple power supply, as shown, may be used, contributing still further to overall cost reduction. The supply voltage is not critical. Any transformer capable of delivering 15 to 30 volts at 1A after rectification may be used, the 5 ohm collector resistors and 1.5K dropping resistors being changed as necessary.

However, the low cost does not imply a sacrifice in performance. The amplifier will deliver 10W into an 8 ohm load, has a low frequency response equal to DC and an upper limit (at the 3dB down point) of about 120KHz. When driven with 500Hz, 1KHz and 10KHz signals, the amplifier shows no measurable harmonic distortion on measuring equipment capable of resolving 0.1pc.

When fed with a 10KHz square wave and operating into an 8 ohm resistive load shunted with a 0.1uF capacitor the amplifier showed no observable sign of ringing or ultrasonic instability. Increasing the capacitor to 1uF resulted in ringing over about 50pc of the half cycle, but there was still no ultrasonic instability. There is also a total lack of crossover distortion at low power levels; an essential feature in any high quality amplifier.

The voltage gain of the unit as it stands is 11 but this could be increased with little loss in performance.

The only constructional notes which should be observed are as follows:

(a) The diode "D" should be mounted on the power transistor heat sink to provide stability against thermal runaway.

(b) The value of resistor "R" should be selected to give minimum quiescent current consistent with no crossover distortion. (Once set up the quiescent current, will be quite small, but the exact value will depend on the output transistors used.

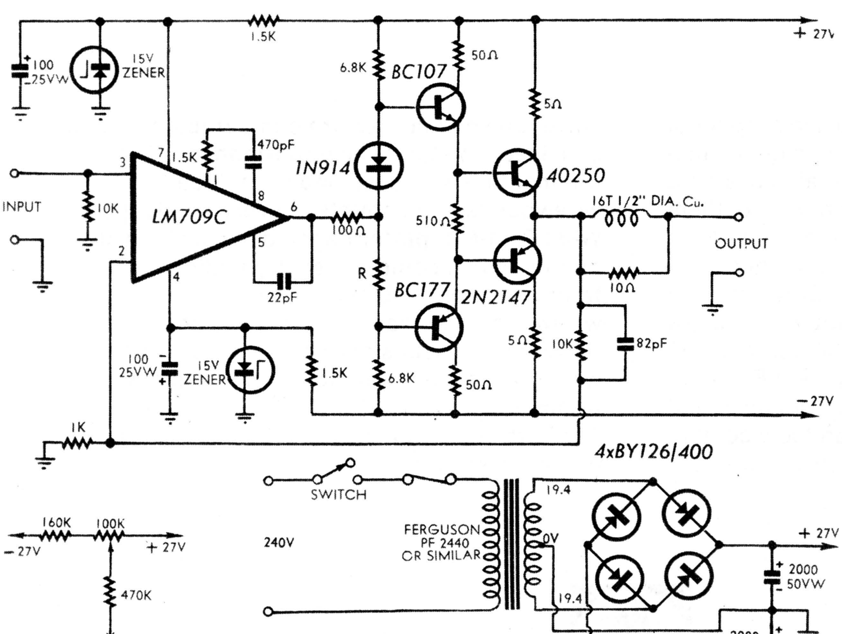
(c) If the integrated circuit has a large input offset voltage (there is a liberal allowance in the specifications) clipping at full power may not be symmetrical. This can be compensated for with the additional circuitry shown. This can also be used to hold the output at a certain quiescent current if a centre tapped power supply is not used. The 100K pot is adjusted to hold the output at a potential midway between the supply rails.

(d) It is advisable to limit the supply voltage to the integrated circuit with 15 volt zener diodes to protect it from excessive voltages which could cause damage.

(e) The 0.1uF decoupling capacitors should be connected to the rails as near to the integrated circuit as possible to minimise any chance of high frequency oscillation.

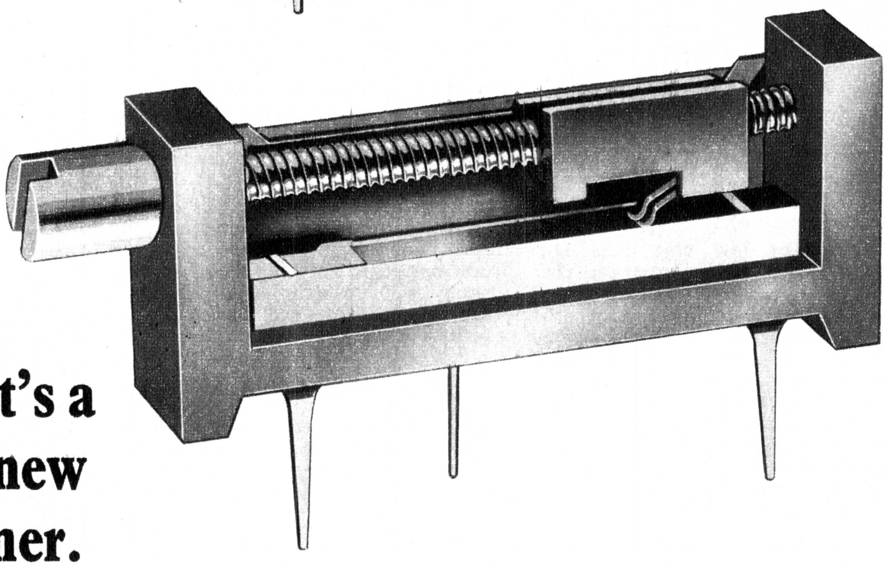
Using a good quality pickup, preamp. and speaker system I have found it impossible to fault the amplifier under any conditions. In fact, results have been so convincing that some people who have heard it are now changing the power amplifier sections of their commercial units to this or a similar design.

(Continued on page 107)



In addition to the main circuit, this drawing shows the suggested power supply and some additional circuitry to provide adjustment of the quiescent current if a centre tapped power supply is not used.

With Film-Met, only the case is the same.



Inside, it's a whole new trimmer.

The element is made by an exclusive Amphenol patented process. We use a vacuum deposition chamber to evaporate 100% metal alloys onto insulating substrates—then protect them against oxidation with noble metal overlays. The result is trimmer performance neither wire-wounds nor cermets can match. Only Film-Met offers both infinite resolution and a low temperature coefficient of 100 ppm/°C. (50 ppm/°C is available on request.) Film-Met trimmers have excellent high frequency and pulse characteristics and low contact resistance variation. Their low thermal and current noise features are comparable to metal film fixed resistors. The new Amphenol Film-Met trimmer line isn't designed to replace wirewounds and cermets in every application. What Film-Met performance does is eliminate circuit design compromise. By adding these trimmers to our line of cermets and wirewounds, we can now match your performance needs perfectly. This could be what you've been waiting for. A whole new trimmer!

For further particulars please contact your nearest distributor.

MSP

47 YORK STREET SYDNEY 2 0233

MANUFACTURERS SPECIAL PRODUCTS PTY LTD

ADELAIDE	BRISBANE	HOBART	LA[illegible]CESTON	MELBOURNE	PERTH	SYDNEY
51 0111	31 0341	34 3836	[illegible]1804	67 9161	28 6400	533 1277 & 29 7031

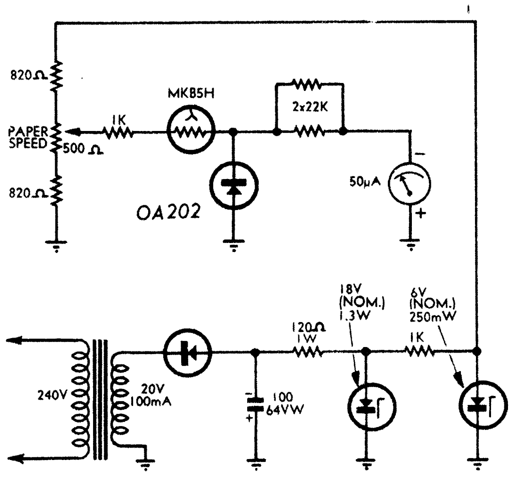
Enlarging Exposure Meter

Amateur photographers may be interested in this latest suggestion for an enlarging exposure meter. The author claims that many of the objections to previous designs can be overcome by using the more sensitive cadmium selenide light dependent resistor.

The use of a CdSe LDR in lieu of a CdS appears to overcome most of the previous objections to this type of a darkroom aid. (R TV and H., March, 1963, page 76). The LDR is certainly small enough and sensitive enough to handle all the negatives I have, measuring the darkest "important" part. The sensitivity is also adequate in the blue region for evaluation of colour negatives through narrow cut tri-colour filters. Unfortunately, the variation between individual LDRs of this type (MKB5H, available from Proops Bros. London) is enormous; the second LDR I obtained recently appears to be only suitable for measuring the brightest part of the negative. This method seems to be gaining popularity and may be as good as the other. The response time of both units is quite satisfactory and very much superior to the "fast response" Cds cells such as ORP 63.

(Submitted by: T. J. Matulevicius, 109 Warrigal Road, Surrey Hills, Victoria, 3127.)

(Editorial comment: We have published the above circuit and comment as an item of general interest to those readers who have been seeking a satisfactory solution to the problem of determining enlarging exposure. However, while the CdSe cell appears to have some advantages over the CdS cell, it leaves some objections unsolved and creates at least one new one of its own. Increased sensitivity and rapid response time are in its favour, as is spectral response, which appears to be in the blue region. Against this is an apparently very wide spread of characteristics and, for Australian readers, the fact that there appears to be no supply in this country. Presumably they would have to be obtained from the English firm mentioned by the contributor.)



The main feature of this circuit is the use of relatively high sensitivity cadmium selenide (CdSe) photocell in place of the more conventional cadmium sulphide unit. The cadmium selenide cell also has improved sensitivity at the blue end of the spectrum. Availability of these cells may be a problem.

Car Burglar Alarm

Here is a simple and inexpensive burglar alarm which may be fitted to any vehicle which has an interior light operated by either of the front doors.

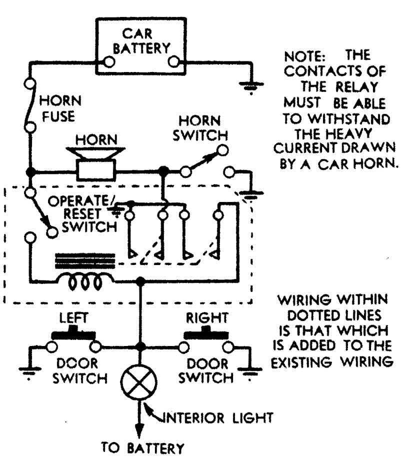
After being set, this alarm will operate the horn of the vehicle until turned off by the reset switch, which is mounted in some accessible, but inconspicuous position on the exterior of the car. Positions for this will suggest themselves to readers studying the construction of their own car. When either of the front doors is opened, a relay pulls in a set of heavy duty contacts which operate the horn. This relay should be of a type to match the voltage of the particular vehicle. The horn contacts must be heavy-duty types, as some horns draw large currents — 10 amps or more in some cases. A second set of relay contacts are required to provide a latching circuit whereby the horn is kept in operation once started. The current carried by these latter is quite modest.

The unit should be wired with fairly thick wire, again for the reason of high current. If the wiring is exposed (e.g. that to the exterior switch) it should be adequately waterproofed. The same applies to the switch itself.

The original unit was installed in a Volkswagen, and has performed with very satisfactory results.

(Submitted by: P. J. Evans, 118 Laura Street, Ekibin, Qld. 4121.)

(Editorial comment): While we have described a number of burglar alarms, some suitable for cars, this design may appeal to readers by reason of its simplicity and economy. One point, however, should be noted; the horn operates until turned off at the reset switch. In the event of the owner being absent for any length of time, and the alarm being tripped, he would return to find a flat battery. Although a car with a flat battery is preferable to a stolen one, readers may care to incorporate some type of time delay switch to turn off the device after a set period.)



Components inside the dotted line are those added to provide the alarm. No polarities are shown and the system is suitable for either convention.

(Editor's Footnote: "Reader Built It" projects are published for the general interest of experiments and as a source of ideas. Based on readers' contributions, they have not been tested in our laboratory and we cannot accept responsibility for them.)

Amplifier — Cont.

(Submitted by: Mr P. L. Rossiter, Physics Department, Monash University, Clayton, Victoria, 3168.)

Editor's note: It would appear that there may be a risk of damage to the driver transistors in the event that either one is "cut off," since both transistors have absolute maximum collector-emitter ratings of 50 volts. In view of this, constructors may wish to substitute higher rated driver transistors or reduce the supply voltage below 50 volts. 2N5322 or 2N3645 can be substituted for BC177 and 40408, 2N2102 or 2N3568 can be substituted for BC107.)

Ask the professional who owns one

'We took Part'
At NASA

Voices recorded from outer space on UHER at the world's leading radio stations B.B.C., A.B.C. etc.

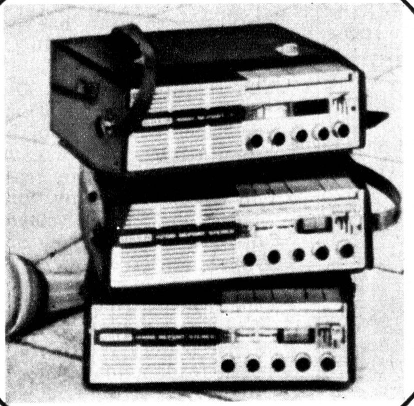
UHER

The world's most reliable name in precision tape recorders

Report 4000L—the most successful Reporter model.

4200/4400 Stereo — the world's smallest hi-fi stereo recorder.

1000 Pilot — the world's most advanced compact lip-synch recorder.



YOU TOO can take part in

ACTION AND SOUND

with

UHER BANDRECORDER

Royal Deluxe — Varicord 23/263 – Universal 5000

BE SURE USE

UHER

YOUR NEXT CHOICE

ATRAM PTY. LTD.

Available from the following franchised PE Agents:—

N.S.W.: John Border Photographics Pty. Ltd. **175 Liverpool St /403 George St.** Sydney. Tel.: 26 1106.

N.S.W.: **Milverson Sound Centre, 791 Pacific Highway, Chatswood. Tel.: 41-4365.**

N.S.W.: **Glen Dor Camera Centre, 43 The Corso, Manly. Tel.: 92-2709.**

N.S.W.: **Camera & Taperocorder Industries Pty. Ltd., Piccadilly Centre, Wollongong. Tel : 2-5525.**

N.S.W.: Photo Hi-Fi Pty. Ltd., 376 Pitt Street, Sydney. Telephone 26 3234.

W.A.: Alberts TV and Hi-Fi Centre Pty. Ltd., **282 Hay St., Perth. Tel.: 21-5004.**

QLD.: A. E. Harrold Pty. Ltd., 123-125 Charlotte St., Brisbane. Tel.: 31-3081.

VIC.: Atram Pty. Ltd., 1 Corr St., Moorabbin. Tel.: 95-5633.

VIC.: Klapp Electronics Pty. Ltd. 224 Chapel St., Prahran. Tel.: 51-4653.

VIC.: **Photosound Pty. Ltd.,** 7 Cookson St., Camberwell. Tel.: 82-7042.

S.A.: **Kallin Distributors (Wholesale) Pty. Ltd., 140 Gawler Place, Adelaide.** Tel.: 23-6055 (11 lines).

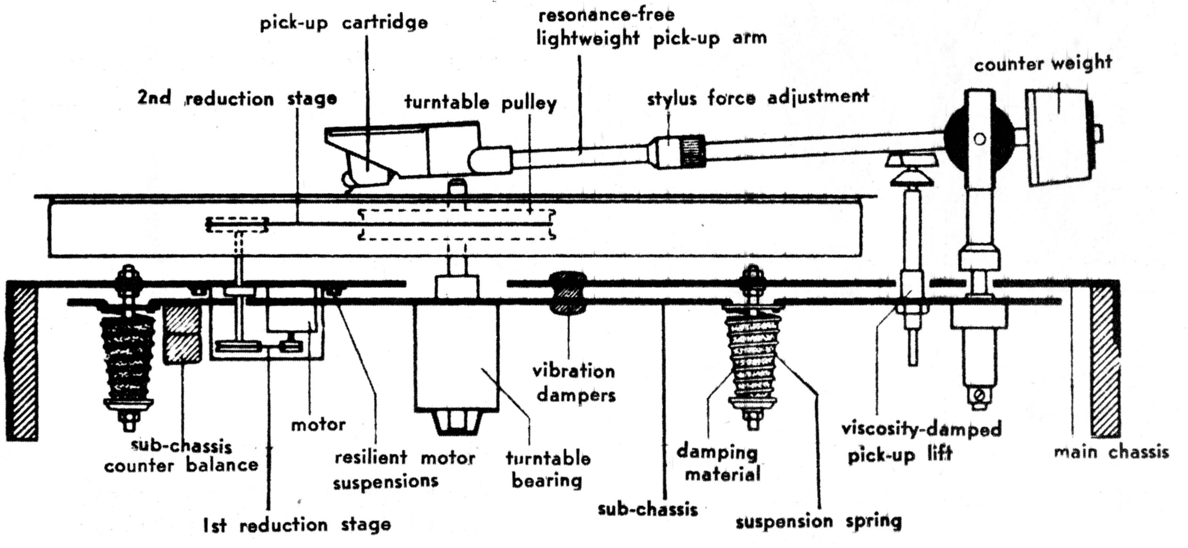
A.C.T.: **Canberra Sound and Recording Service, 109 Majura Ave., Dickson.** Tel.: 47-7980.

N.T.: N.T. Musical and Electrical (W/S) Pty. Ltd., 54 Cavanagh St., Darwin. Tel.: 3072.

AUDIO TOPICS

Electronically controlled turntable deck based on new principles

Recently announced in Europe by the Philips organisation is a new type of gramophone turntable deck with speed control device which departs radically from conventional techniques. Called the GA202 "Electronic," the turntable uses an all-electronic system to control the speed of rotation and to switch off the unit.



One of the most significant developments in the design of this deck is the use of a DC motor, the speed of which is constantly monitored and controlled by fully stabilised transistor circuitry. Drift, wow and flutter are suppressed in microseconds, claim Philips, and the motor is isolated from mains voltage fluctuations and independent of mains frequency.

It is claimed that, because the need for the flywheel effect of a heavy turntable is eliminated, the whole moving system can be made much lighter. This reduces the load on the motor and main bearing so that this system can be mounted on a free-floating sub-chassis while the controls are placed on a rigidly mounted plinth unit. Such an arrangement gives substantially increased immunity to external shock and vibration.

Switching on and off is done silently by means of a bi-stable multivibrator. Automatic switch-off at the end of a record is achieved by means of a photo-electronic circuit operated by a vane attached to the pick-up arm. The advantages of this system are two-fold. There are no additional mechanical forces operating on the pick-up arm, thus there is no undue wear on the record or stylus. Also the pick-up can be placed in any groove of the record, no matter how close to the run-out groove, without premature tripping.

As the motor speed is electronically controlled, speed selection is carried out by switching electronic circuits and each individual speed has its own fine adjustment control.

The pick-up arm has been designed as a result of mathematical analysis so that the actual tracking error is within a small design value, independent of the unavoidable tolerances on off-set angle and overhang.

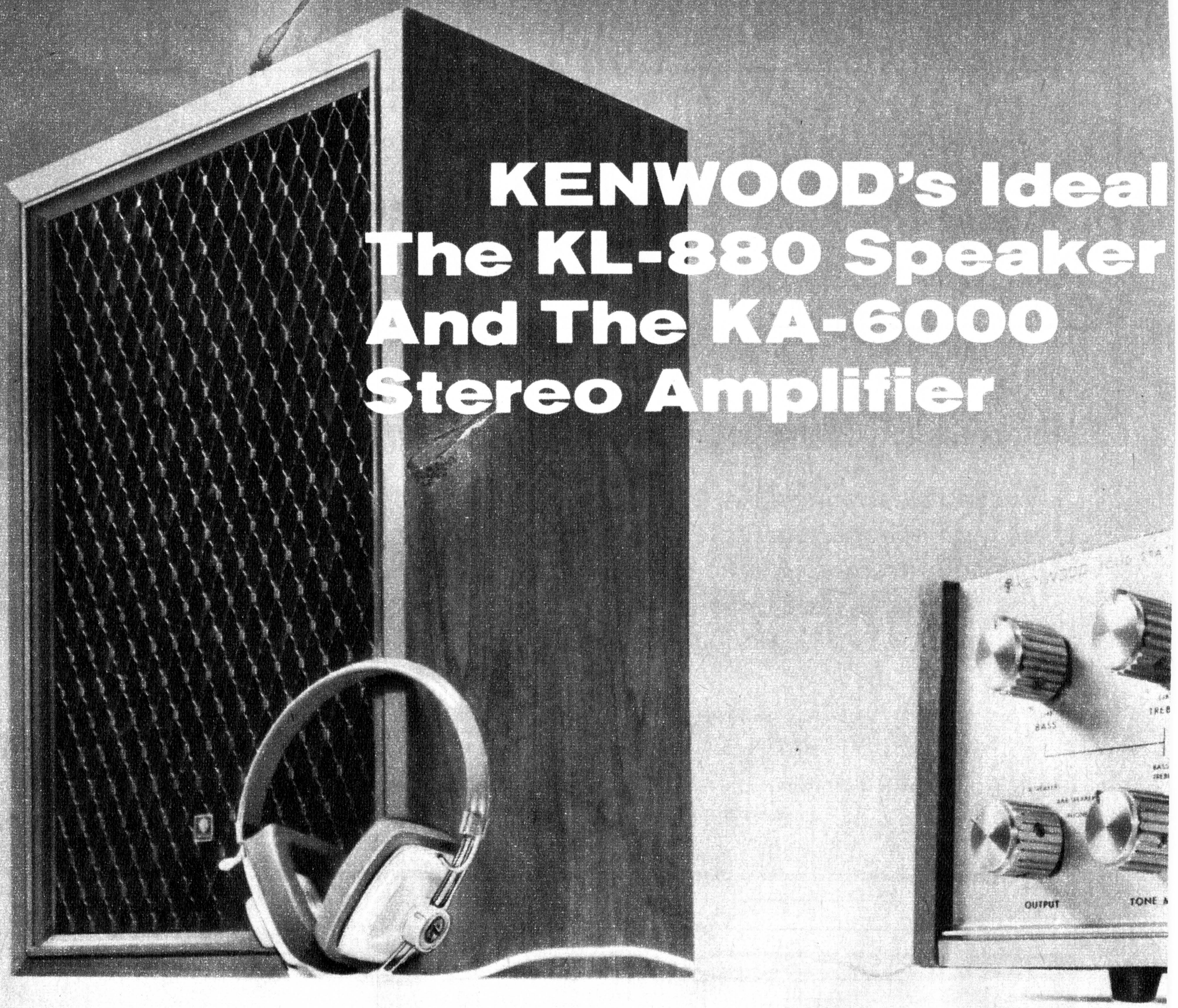
To complete the picture a new cartridge, called the Super M, designed for use with the turntable, employs the latest advances in the field of micro-engineering including a magnet hardly larger than a grain of wheat and ten times lighter than a postage stamp but having a nominal flux density of 8,500 gauss.

The main features of the design are illustrated in the diagram.

To isolate them from shocks and external vibrations, the turntable and the pick-up arm have been mounted on a sub-chassis which is suspended from the rigidly mounted main chassis.

This construction permits considerably more flexible springs to be used than when the entire chassis is spring-mounted. In the latter case, the flexibility of the springs is restricted, because the operation of the controls must not cause appreciable movement of the record deck. The advantages of the new system are threefold: better isolation of the critical parts against shock and vibrations, more accurate cueing as the movement of the arm-lift lever does not cause any displacement of the sub-chassis, and better damping of the effects of heavy shocks. As the motor is independently suspended underneath the main chassis, the pick-up arm is doubly isolated against vibrations. ("Electronics Weekly".)

KENWOOD's Ideal The KL-880 Speaker And The KA-6000 Stereo Amplifier



SPEAKER SYSTEM
KL-880

HEAD PHONE
HS-3

Perfect performance mates—that's KENWOOD's KL-880 4-way, 5-speaker system and the KA-6000 stereo amplifier.
Sound as it really is—not as it almost is. That's an extra you get because the KL-880 has a 15-inch free-edge woofer, a 5-inch cone type midrange and horn type high midrange squawkers.
Add two horn type tweeters and KENWOOD provides you with amazing ultra-angle treble dispersion.

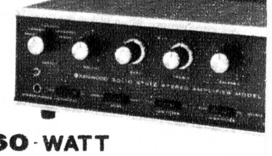
The KA-6000 is a power-packed 180-watt stereo amplifier that drives life into Hi-Fi speakers of lowest possible efficiency. Combined with the KL-880 they're an unbeatable stereo team.
There's wide power bandwidth of 10 Hz to 50,000 Hz with low-low IM distortion. And the KA-6000 has exclusive low level phono inputs for low level output phono cartridges of 2 mV, 0.5 mV or 0.05 mV.
For personal, exclusive enjoyment there's

120-WATT SOLID STATE STEREO AMPLIFIER KA-4000

* The wide power bandwidth of 13 Hz to 30,000 Hz with very low IM distortion.
* Lever type-20 dB muting switch of quick response for momentary quiteness during telephone call, etc.
* Dimensions: 16-5/16"(W), 5-5/32"(H), 11-1/32"(H)

40-WATT SOLID STATE STEREO AMPLIFIER TK-150U

* 5 pairs of input terminals for MAG, AUX 1, AUX 2, TAPE REC and TAPE PLAY.
* Damping factor: 40 (at 16 ohms), 20 (at 8 ohms)
* Dimensions: 10-1/4"(W), 4-1/8"(H), 9-3/8"(D)



60-WATT SOLID STATE STEREO AMPLIFIER TK-250U

* 2 sets of stereo speaker terminals and front panel speaker selector switch.
* Dimensions: 13"(W), 4-1/8"(H), 9-15/16"(D)

Connection: System

180-WATT SOLID STATE STEREO AMPLIFIER KA-6000

the HS-3 headphone accessory.
So, put these KENWOOD giants together and add true stereo enjoyment to your life.
KENWOOD has a distinguished array of models operating with less power, but at top quality.

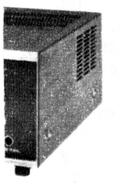
the sound approach to quality

KENWOOD

TRIO ELECTRONICS, INC.
6-5, 1-CHOME, SHIBUYA, SHIBUYA-KU, TOKYO, JAPAN

Sole Agent in Australia: Jacoby Mitchell & Co. Pty. Ltd.: Head Office: 469-475 Kent Street, Sydney. Tel.: 26 2651. Melbourne: 15 Abbotsford Street. Tel.: 30 2491. Brisbane: 56 Edward Street. Tel.: 2 6467. Adelaide: 652 South Road, Glandore. Tel.: 53 6117. Perth: Jayem Electronics, 252 William Street. Tel.: 28 8102. Tasmania: K. W. McCulloch Pty. Ltd., 57 George Street, Launceston. Tel.: 25 322. Newcastle: Edmunds Moir & Co. Pty. Ltd., 18 Wood Street. Tel.: 61 4991. **Distributor in New Zealand: JOHN GILBERT & CO.,** Tasman Buildings, Anzac Ave., Auckland, C.1.

Ask for a catalogue or demonstration by your nearest dealer.



30-WATT
FET SOLID STATE AM/FM STEREO RECEIVER TK-20U

* F.E.T. (Field Effect Transistor) 3-Gang Tuning Condenser frontend for superior sensitivity, image rejection and cross modulation ratio.
* Dimensions: 14-1/16"(W), 4-3/4"(H), 11-1/4"(D)

To: Jacoby Mitchell & Co., Pty., Ltd. EA
469-475 Kent St., Sydney.

Send me information on KENWOOD RECEIVERS, AMPLIFIERS, SPEAKERS & name of nearest KENWOOD retailer,

NAME: ____________ AGE: ______

ADDRESS: ______________________

____

LOUDSPEAKER POWER RATINGS

This brief article discusses a problem which very commonly faces hi-fi enthusiasts: Can they use modestly powered loudspeakers with much higher-powered amplifiers? What can be done to protect the loudspeakers against overload and possible damage?

In recent years, there has been a very noticeable escalation in the power output ratings of amplifiers intended for domestic use.

This has largely been the result of a transition to solid-state circuitry and to the development of output transistors with progressively higher power ratings, at little or no increase in cost. This has made it possible for designers to achieve progressively higher power ratings from domestic hi-fi stereo amplifiers, without the cost, heat and space penalties which would have attended any such efforts with valve circuitry.

Not surprisingly, something of a "power race" has resulted, with rival manufacturers offering and emphasising high power ratings, without too much regard as to whether such figures are necessary in an ordinary domestic situation.

Having had their attention focused on power output, it is again not surprising that purchasers should ask questions about loudspeaker ratings. If they purchase an amplifier rated to deliver 50 watts of continuous power per channel, would it not be logical to couple it to two loudspeaker systems with a similar power rating?

The answer, undeniably, would be: "Yes, it would be logical, but . . ."

The "but" arises because effective high power ratings are not nearly as easy to achieve in wide-range loudspeaker systems as they are in wide-range amplifiers. There are likely to be severe penalties in terms both of cost and size.

While one can argue and speculate about the exact significance of loudspeaker power ratings, it is reasonable to assume that such a rating at least implies that:

(a) The loudspeaker will accept the full undistorted output of an amplifier capable of producing that amount of power on ordinary program material, including any likely content of heavy bass, sustained complex tones, and etc.

(b) The loudspeaker can be used under these conditions for lengthy periods without voiding any guarantee, suffering physical damage or reducing its effective "life" to an unreasonable period.

(c) The acoustic output will simultaneously contain no more inherent frequency and harmonic distortion than envisaged in other ratings or implied by any description of the loudspeaker as a "high fidelity" unit.

(d) It will transduce the electrical power input to acoustic power output with an acceptable degree of efficiency.

This last point is most important in evaluating the relative merit of a loudspeaker system. If its acoustic efficiency is low, it may have a generous power rating simply because it needs more electrical input to produce a given physical — and acoustical — end-result.

Basic to the concept of a higher-powered loudspeaker is an assumption that it will be able to produce a higher level of sound than a more modestly rated unit. This means an increase in the amount of energy which it can couple to the surrounding air as sound wave — a task that becomes notably difficult in the bass register.

Translated into practical terms, the task of imparting increasing amounts of energy to the surrounding air may involve the use of progressively larger cones, able to move back and forth in linear fashion through the necessary distance.

Alternatively, if the cone size is restricted or even reduced in a higher-powered loudspeaker, the reduction in cone area has to be compensated by a considerable increase in cone travel, or the distance through which the cone can oscillate.

In either case, the combination of these escalating requirements with those normal to the design of a high fidelity loudspeaker results in a much more expensive unit, to which is likely to be added the extra cost of a larger, or more robust, or more elaborate enclosure. The end result is that, having purchased a high-powered stereo amplifier, many enthusiasts find that loudspeakers with comparable power ratings are more than they can accommodate, in terms of cost or space.

The question then follows as to whether they can use 50-watt amplifier channels with, say, 15-watt loudspeakers, these being the best they can afford.

Will the amplifier "blow up" their loudspeakers? If so, can they do something to limit the power output of the amplifier?

A suggestion that is sometimes made is to put a mark or a stop on the volume control so that it will not be turned past a certain point. In fact, this is not much help because of the varying nature of input signals, even from a single source. Say, for example, that the volume control was limited so that the amplifier would deliver a nominal 15 watts maximum on loud passages in a fairly lightly recorded record. It is entirely possible that the next record would produce double the signal input for the same volume control setting and therefore allow four times the power — or 60 watts — to reach the loudspeakers. Even greater difficulties might arise from signals of quite different level taken from tape deck of radio tuner.

Another idea sometimes put forward is to impose an artificial limit on the output of the amplifier by some sort of

external peak clipper. Such a scheme could conceivably impose an artificial overload point at the 15-watt level but, in so doing, it would negate any advantage of buying the high-powered amplifier in the first place. Also, unless such a limiter was very carefully engineered, it would cause the output transistors to look into a very low value of load, possibly with disastrous results.

A still further possibility put forward is to make the loudspeakers only part of a total output load, the rest being made up of series and parallel high-dissipation resistors. While this would avoid any risk to the amplifier output stage, it would still completely negate any value of the high-powered amplifier, which would have to work "flat out" at 50 watts to drive the loudspeakers to 15 watts. For all practical purposes, the amplifier might as well have been a 15-watt unit in the first place.

A further point that should be made is that an amplifier which is able to deliver clean audio up to, say, 15 watts will be able to deliver a much higher output than 15 watts, if pushed into the overload region. This is true whether 15 watts represents the natural power limit of the amplifier or one that is artificially imposed.

In short, using a loudspeaker system only with an amplifier of equivalent power rating does not provide an automatic guarantee against at least nominal loudspeaker overload.

In fact, in the typical case, there is a good deal of justification for the idea that the best way around the difficulty is to rely, not on technical measures but on plain common sense.

It can probably be assumed that anyone installing a high-powered amplifier will provide it with loudspeaker systems having a power rating in the 10-15 watt range. Two such systems can provide more than enough level for a living room without running beyond their normal power rating. It therefore follows that, if the volume control is used in the normal way to provide no more level than is necessary in the home, even by generous standards, a pair of 10-15 watt loudspeakers will be quite safe, irrespective of the amplifier's maximum power rating.

In other words, it is not a question of marking the volume control setting but of simply turning it up only far enough on any given input, to provide the necessary (but logical) listening level.

The main reasons why 10-15W loudspeakers might be overloaded would be:

(a) If the owner turned up the volume to an extreme level to impress a visitor, or

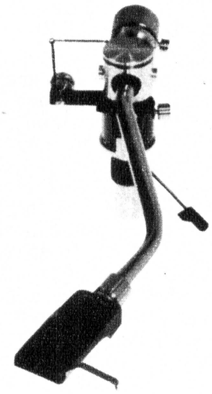
(b) Turned up the volume with the bass control full on, just to feel the floor vibrate!

A further justification for relying on common sense is that loudspeakers are not prone to "instant" wrecking. If they are over-driven, the output will sound very distorted, particularly in the bass register. The voice coil may even "bottom" against the magnet structure. But, provided the overload condition is not sustained, the loudspeaker will seldom suffer any permanent damage.

In short, the owner can protect loudspeakers in the longer term by discreet use of the volume control. The loudspeaker's built-in tolerance will

(Cont. on page 189.)

ADELAIDE'S BEST VALUE!



NEW CORAL A-550 AMPLIFIER!

Coral Audio Corporation, one of Japan's leading manufacturers, have released a new, top-quality, all-silicon transistor stereo amplifier of advanced design. Here are some of it's remarkable features!

- Special high-sensitivity input for moving-coil pick-ups . . . 40 micro-volts (eliminates transformer).
- Normal magnetic cartridge input sensitivity . . . 2.5 milli-volts.
- Advanced negative feedback tone controls.
- SCR transistor protection circuit.
- Frequency response . . . 20-40,000 Hz plus or minus 2 db.
- Power bandwidth . . . 25-40,000.
- 18 watts r.m.s. per channel at less than .8 p.c. harmonic distortion.
- Low-level listening compensation circuit.
- Tape monitor circuit.
- Front panel switch allows selection of two stereo speaker systems.
- Richly grained teak cabinet.

THE CORAL A-550, an outstanding amplifier! $175.

MICRO AUDIO PRODUCTS PROVE POPULAR AT CHALLENGE!

Advanced research and strict quality control single out Micro products from inferior brands. Illustrated above is the new Micro MA-77 Mk. 2 tone arm. Precision knife-edge bearings allow the arm to track suitable cartridges as low as ¼ gram and thorough de-coupling eliminates feedback. An ingenious bias system effectively counteracts the skating effect. The arm includes an exceptional hydraulic lifting-lowering device. Considering it's performance, the MA-77 Mk 2 arm must rank with the best pick-up arms available.

Micro MA-77 Mk. 2. arm .. $44.50.

Micro magnetic cartridges set new performance standards for low-cost pick-ups! The Micro 3100/e cartridge with elliptical stylus features genuine low tip mass found only on far more expensive cartridges. Performance is particularly satisfying . . . separation exceeds 30 db at 1 Khz, frequency response is 20-28,000 Hz and is free of resonance throughout the audible range. Tracking ability of the 3100/e is excellent and the cartridge is extremely well shielded against external hum fields.

Micro 3100/e cartridge .. .. $24.50.

Connoisseur Turntables

Stocks of the new belt-drive turntables are once again in our store. Acceptance of these new models has been immediate and many were disappointed at missing out on our first shipment. Illustrated below is the CONNOISSEUR BD1 TURNTABLE. It features a cast non-ferrous platter, well-shielded 14-pole synchronous motor and heavy-duty drive belt. Performance is outstanding—rumble, wow and flutter and hum radiation are extremely low. Price of the turntable in Kit form is only $33.50. Also illustrated is the LUSTRE ST-510D TONE ARM. Constant demand indicates that the ST-510D is one of the most popular arms ever marketed in Australia. The curved S-shaped design ensures low tracking error and eliminates audible resonances. The low price of $24.50 includes an integrated hydraulic lift!

Lustre Tone Arms

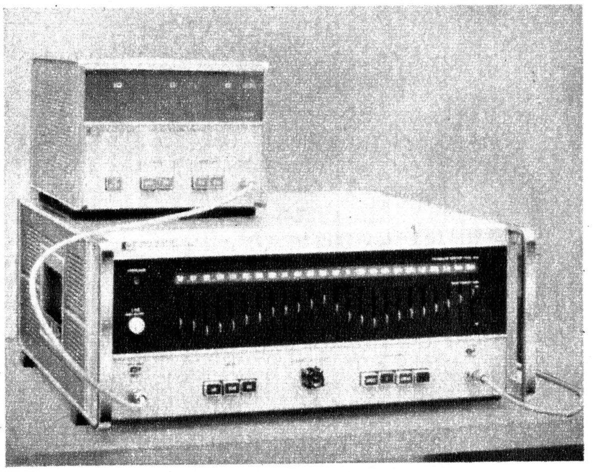
Challenge

RECORDING CO.

HI-FI STEREO CENTRE

6 GAYS ARCADE, ADELAIDE.
(off Adelaide Arcade)
Phone 23-2203.

Filter Set allows visible setting of frequency spectrum



Hewlett-Packard Model 8056A Filter Set. Note how the settings of the attenuators give an indication of frequency spectrum.

Details of a new filter set which makes it possible to modify or shape the frequency spectrum of audio-range signals have been released in the U.S.A. by Hewlett-Packard.

The Hewlett-Packard Model 8056A Filter Set consists of 24 one-third octave filters connected in parallel. Each filter channel has an individually adjustable attenuator that allows the user to set the instrument's response to each one-third octave band of frequencies.

The primary purpose for filter sets such as these is in vibration testing. When connected to the output of a noise generator, a filter set can modify the noise spectrum to obtain signals representative of the type of vibration to which the tested equipment might be used in a real life situation; or the filter set can be used to compensate for deficiencies in driver or transducer frequency response. They are also used in sound reinforcement systems to compensate for the uneven frequency response of auditoriums and concert halls; and in recording and broadcast studios for modifying sounds.

The attenuators are adjusted by small thumbwheels that roll up and down to give a visual indication of attenuator settings and hence of the instrument's transmission characteristics. Each attenuator is continuously adjustable over a 40dB range which, because of gain provided in the instrument, covers a range of —20dB to +20dB. To compare a shaped spectrum with the unmodified spectrum, the instrument can be switched to function as a broadband, linear amplifier.

The new filter set can also be used with other instruments as a spectrum analyser: any one filter alone can be switched to the output for measurement of the signal level in that frequency band. For this application, a single front-panel pushbutton switches all channels to have 0dB gain, and another pushbutton switches all to 20dB gain. All the filter outputs are individually available simultaneously at a rear-panel connector, permitting use of the filter set in systems with automatic scanners.

Both input and output have selectable impedance: 600 ohm or 100K for the input, and 50 ohm or 600 ohm at the output. This arrangement simplifies applications of the Filter Set with a broad range of ancillary equipment.

In applications of a Filter Set to signal spectrum shaping, signal overload often is not easily recognised. A new, fast-acting overload circuit in the Model 8056A lights up if either input or output are overloaded for more than 0.1mS.

In its standard configuration, the Model 8056A has one-third octave filters with centre frequencies ranging from 50Hz to 10KHz. Other sets of filters, each spanning a 200:1 frequency range down to 2Hz or up to 40KHz, are available.

CLASSICAL RECORDINGS

Reviewed by Julian Russell

BEETHOVEN—Fidelio Opera. Martti Talvela; Theo Adam; James King; Gwynneth Jones; Franz Crass; Edith Mathis; Peter Schreier. Dresden State Orchestra and Leipzig Radio Choir and Dresden State Opera Chorus conducted by Karl Bohm. DGG stereo 643614-6.

This year, to celebrate the bicentenary of Beethoven's birth, DGG has embarked on the enterprise of issuing his complete opus — a gigantic undertaking which, alas, to cover fully would not be practicable in the space at my disposal. I am therefore taking Fidelio as a sample and can state at the outset that if all the other issues are of this standard the collection will be rich indeed. The only other set I have heard worthy of comparison is the Klemperer, but since both conductors' readings differ and both have valid reasons for their own interpretations your preference will be wholly personal. Overwhelmingly in favour of the DGG set is Bohm's striking of what seems to me to be the perfect tempo for every item and attention to detail that never fails to illuminate the text. I can't remember when I have heard more accurate and expressive playing than that offered by the Dresden woodwind. The strings, too, have a fine big tone, but lack a little of the lustre of some of their colleagues in other fine orchestras. The brass, in tone and attack, are quite wonderful. On the other hand I find Klemperer's cast slightly more appealing than Bohm's in some of the roles — particularly those sung by Christa Ludwig, Walter Berry and Jon Vickers. But against this I can wholly endorse the youthful-sounding Gwynneth Jones (Leonore), who, despite a few very rare moments of uncertainty, offers a truly radiant performance. I liked, too, James King (Florestan), though in this role my allegiance goes to Klemperer's Vickers. I thought Theo Adam uninteresting as Pizzaro, not comparable in any way to Walter Berry, but Franz Crass' Rocco is unremittingly appealing. There is nothing much to choose between those singing the smaller roles in both sets.

The Dresden choristers are superb and Bohm keeps the whole work moving steadily towards its climax in a manner that is never interrupted by achieving a momentary effect. Perhaps, as might be expected, Bohm's reading is not quite as massive as Klemperer's. You might think from what I have written that the DGG set is slightly inferior to its rival. This is in no way true. A little cooler, perhaps, and sometimes, rather surprisingly, a shade slower in tempo. But it has its own special virtues that I have tried to set out above in the space available—an item-by-item comparison would be as dull as it would be confusing — and some listeners might find that it is just the performance they have been waiting for. The sound is first rate and a well-bound libretto in English, French and German accompanies the boxed set of three records.

* * *

DEBUSSY — Iberia. Danses Sacrees et Profanes. Cleveland Orchestra conducted by Pierre Boulez. CBS Stereo SBR235344.

I am of the opinion that Iberia is Debussy's finest work for orchestra, though I am aware that there are many who might differ. It is technically perfect, imaginatively evocative, genuinely Spanish in atmosphere, and has, especially in the slow movement, perhaps the most ravishing theme Debussy ever wrote. I refer, of course, to the delicious oboe melody. I have frequently, in this column, described the Cleveland under their martinet director, George Szell, as the finest precision instrument playing today. And this is an opinion based not only on their recordings, but on having heard them live in Vienna, Amsterdam and other European capitals during the past few years. Boulez, if one excepts his astonishingly good performance of Handel's Water Music with the Hague Philharmonic a few years ago, has a somewhat limited repertoire in the record catalogue, but everything he records is admirable.

Iberia is no exception. And if, in the nature of things, the Cleveland horns have a little more body in them than is ideal for Debussy's sound, at least they don't produce the squashy timbre you get from many French orchestras. Boulez is not a showy conductor, nor is he over-careful or pedantic. Except for very rare deviations — I have in mind some of the vocal parts in his recording of Berg's Wozzeck — he observes the composers' desires with the utmost integrity. Iberia has been often recorded — I can recall an old 78 back in the late 1920s conducted by Lenau and, I think, the Paris Conservatoire Orchestra — and the different conductors have here and there used different tempos from the present reading by Boulez. But a glance at the score will reveal Boulez' accuracy in interpreting Debussy's intentions, not only in tempo, but in phrasing. For my taste, his is the best I have heard so far.

The only comparable account I can recall is that by Ansermet and the Swiss Romande, and the Cleveland players are way out in front of their Swiss colleagues in tonal quality and even in technique. This is not to disparage the Ansermet version (Decca), which still stands up very well to the closest scrutiny. But I prefer the new CBS.

On the second side are Debussy's Sacred and Profane Dances. This is not the first time I have heard Boulez conduct these two exquisite little pieces. In 1962, in Darmstadt, where I had been invited to attend the summer school for avant garde music, he conducted them, not for orchestra, but for a double string quartet consisting of the Parrenin and the La Salle with, of course, a solo harpist.

The odd thing to me was that an audience assembled to listen to the mind-fracturing exercises in avant garde sound encored the Debussy, and this the only work to be repeated during the whole of the 10 days and 10 nights course. His playing of them on this disc I found quite enchanting.

* * *

MUSIC TODAY VOLUME 9.
Busoni — Berceuse Elegiaque.
Wolpe — Piece in Two Parts for Six Players.
Dallapiccola — Sex Carmina Alcaei; Piccola Musica Notturna; Preghiere. Heather Harper; Barry McDaniel. English Chamber Orchestra. New Philharmonia Orchestra conducted by Frederik Prausnitz. Record Society Stereo No. S 6327.

Strictly speaking, the Busoni Berceuse does not belong to this Music Today series, but rather to the world of late Mahler. It is a deeply moving piece of lyricism, reminiscent of the Mahler of the Ninth and Tenth Symphonies. It should offer no problems to those who accept Mahler as a recognised landmark in the development of what has become the standard repertoire. The other works are not so easy to appreciate at first hearing. Dallapiccola, despite his 12-tone technique, cannot quite shake off the innate Italian virtue of writing lyrically for the human voice. A deep conviction of the value of melody persists in spite of unswerving allegiance to more modern treatment. His Piccola Musica Notturna, which might be literally translated as Eine Kleine Nachtmusik, has periods of enchanting serenity punctuated by sudden outbursts of violence, the whole proving something a good deal worthier than just novelty.

The Alceus songs, though strictly formal in construction — a closer examination will disclose their canonic treatment — also have considerable charm enhanced by the beautiful and perceptive singing of Miss Harper, and to a slightly lesser extent, Barry McDaniel.

You will have to work much harder to get anything out of the Wolpe pieces, but if you are prepared to repeat them several times they will yield up unexpected eloquence.

The playing throughout the whole disc is beyond criticism — though I admit that I write this without having followed the music with a score. And

the magnificent fidelity of the sound reveals piquant sonorities which, on their own, should sustain interest until you familiarise yourselves with the music's other virtues. All three composers represented are somewhat outside the current trend of avant garde music. And although this doesn't make any of them accessible without some fairly intensive application, you should find much that is rewarding if you're prepared to use your mind as well as your ears.

★ ★ ★

DVORAK — Symphonic Variations for Orchestra. Serenade for String Orchestra in E Major. London Symphony Orchestra conducted by Colin Davis. Philips stereo SAL370X.

The Symphonic Variations are high up in the list of my favourite works of Dvorak. For that reason I had already welcomed this disc before I put it on my turntable. I was not disappointed. The Variations is great, gutsy music which still pays some small tributes to Brahms, but without any loss so far as I am concerned. Turn your volume control up a little higher than usual and, if your taste coincides with mine, you'll be in for a treat. The work is shamefully neglected on modern concert programs and has, as far as I can trace, only been recorded once before in recent times—back in the 1950s by Sargent. This makes the new version still more welcome. The 27 variations, unmistakably related to the theme so that there is no difficulty in following the composer's line of thought, are in varying mood — gay, serious, relaxed, dainty, forceful and graceful, with a rousing coda, extended as was invariably Dvorak's practice, that brings the whole to an exciting finish. It is obvious that all departments of the orchestra are having just the same whale of a time as the conductor.

If the variations appeal to you, you will be utterly charmed by the Serenade for Strings. It is a gentle work, persuasively lyrical and immediately rewarding. This, too, receives the most affectionate treatment imaginable from the LSO and Davis. By the way, the surface on this disc is very quiet, so that it is quite safe to turn up the volume without surface noise becoming tiresome.

★ ★ ★

BRAHMS — Variations on a Theme by Haydn (St. Anthony). Variations on a Theme by Handel (arranged for orchestra by Edmund Rubbra). Philadelphia Orchestra conducted by Eugene Ormandy.

Unlike Dvorak's Symphonic Variations, Brahms' St. Anthony Variations can still be heard from time to time in Australian concert halls. I can't think why, though I admit that the Brahms is the more mature of the two. I don't have to tell you that the tone of the Philadelphia is much more luscious than that of the L.S.O. and that it suits the Brahms variations admirably. Faultless engineering and playing make these two pieces a most attractive disc. In the exhilarating "hunting" variation with its horn chorus, these instruments in the Philadelphia produce a real "Waldhorn" tone, quite unlike the

ADC's THREE STYLUS STEREO CARTRIDGE

Q. Is this the world's finest?

A. CBS Labs U.S.A., says most emphatically, YES!

NOW ONLY $1000.00! (PROMOTIONAL PRICE)

For some years the best efforts of the world's leading cartridge manufacturers have failed to improve upon the technical excellence of the ADC. 10E Mk. 2. There are certainly a few fine cartridges which can be compared at this level of the art, but only ADC, through the genius of Peter Pritchard, has again been able to achieve a scientific breakthrough in design of such magnitude as to bring you the **CARTRIDGE OF THE FUTURE RIGHT HERE AND NOW.**

Here are a few excerpts from CBS Labs. report in the December 69 issue of HIGH FIDELITY MAGAZINE, U.S.A.:—

"Who needs three different styli for one cartridge? You may, depending on what kind of records you own and how fussy you are about playing them . . . the INDUCED MAGNET DESIGN, which the ADC.25 employs, can be credited with reducing the over-all mass of the moving system in a pickup and simultaneously with achieving very high stylus compliance . . in fact, ADC—which has always been known for high compliance in its pickups—has outdone itself with the Model 25; its compliance, as measured by CBS Labs., **WAS AN UNBELIEVABLE 120 UNITS LATERALLY AND AN EQUALLY INCREDIBLE 56 VERTICALLY.** We know of no pickup that comes near these figures . . . this amount of compliance, combined with the unit's very low mass, enabled the Model 25 to track the demanding test bands 6 and 7 of CBS STR 120, and the glide tones on STR 100 **AT AN UNPRECENDENTED LOW STYLUS FORCE OF 0.25 GRAM.** For playing normal commercial discs, the lab found that a mere 0.5 gram was ample. The ADC.25 is a superb top-ranking pickup exhibiting the fabulous (for a cartridge) response of plus or minus 1.5 db from 20 Hz to 20,000 Hz . . . **THE 0.3 by 0.7 MIL TIP EXHIBITED THE LOWEST DISTORTION YET ENCOUNTERED FOR A PICK-UP** . . . used in a high-quality arm within its recommended stylus-force range, and with correct bias force adjusted, **THE ADC.25—WITH ANY OF ITS STYLI—WILL PLAY YOUR RECORDS WITH WHAT IS, AT THIS STATE OF THE ART, UNSURPASSED CLARITY AND ACCURACY, AND MINIMUM GROOVE WEAR.**"

The ADC.26 has precisely the same high performance characteritics as the ADC.25, but costs less because it comes with one stylus. The two additional styli can be added at your convenience in order to achieve the ultimate in sound reproduction.

(ADC 26 NOW ONLY $75.00!)

J. H. REPRODUCERS CO.

293 HUNTINGDALE ROAD, CHADSTONE, VICTORIA. 3148

TELEPHONE: 277-3066

Exclusive Australian Agents for — ADC Cartridges and Amplifiers, Kef speakers, J. H./G. H. Unipoise Pickup Arms, Pritchard Arms, TRANSCRIPTOR TURNTABLES and the popular J.H. Synchronous Turntable.

dreamy, mysterious quality of English players or the rather squashy sound of the French. Ormandy gives each variation its own individual character while keeping the whole set consistently Brahmsian. His tempos are just right and the phrasing impeccable.

The Handel set is not so well known. It is for the most part more light-hearted than the St. Anthony in a manner unusual for Brahms. The scoring, too, is unlike that found in most of the master's other works: There is little of his customary thickening of the inner parts. Instead you can sometimes find a hole in the middle, producing a clear top and bottom sound favoured by more recent composers. It starts with some brilliant trumpet playing of the theme — trills and all — follows this with a dancing oboe and goes cn for the most part in a happy progress toward its satisfying coda. Thoroughly recommended to the more orthodox minded collector. I doubt if a better will appear for a very long time.

★ ★ ★

MEISTER IHRES INSTRUMENTS (Masters of Their Instruments). Vol. 1, Stefan Askenase.

Mendelssohn — Songs Without Words in E Major, C Major and A Minor; Scherzo in E Minor.

Schubert — 12 Landler and Waltzes.

Liszt — Liebestraum No. 3 in A Flat Major; Valse Oubliee in F Sharp Major.

Chopin — Scherzo in B Flat: Berceuse in D Flat Major: Barcarolle in F Sharp Major. DGG Stereo 135130.

I cannot work up much enthusiasm for the pedantic playing of this record. The Bee's Wedding tends to plod with affected accentuation. And Askenase — not to be confused with Vladimir Ashkenazy, a younger and more brilliant pianist — makes Schubert's charming Landler and Waltzes a solemn experience. On the other hand, I think most listeners will approve the Liszt Liebestraum despite Askenase's slight hesitations at the cusps of phrases. Again he makes Chopin's Berceuse altogether too serious an experience with even the tendril-like decorations too studied to add much in the way of sheer enjoyment of their spontaneous generation. Liszt's Valse Oubliee receives a run of the mill performance, scholarly rather than charming. Although I found the whole disc very much lacking in humanity those seeking nineteenth century romantic music treated with unremitting earnestness might well approve of this type of playing.

The piano tone has a longish reverberation period which takes a little getting used to, but the ear soon adjusts to it.

★ ★ ★

MOZART — Symphony No. 41 in C Major (Jupiter). Symphony No. 31 in D Major (Paris). English Chamber Orchestra conducted by Daniel Barenboim. HMV Stereo OASD 2379, Series 575.

When Daniel Barenboim started to conduct — at that time his reputation as a phenomenally gifted pianist was already secure — he was lauded by most critics and laymen alike. Now doubts have started to creep in, especially about his Mozart. And purists who listen to his latest Mozart offering are in for a treat picking faults in style in these two, to me, impressive performances. But that they are valid interpretations — and exciting ones — few would be hidebound enough to deny. Both have enormous vitality with a just measure of delicacy and refinement. In the English Chamber Orchestra he is conducting one of the very finest combinations of its kind in the world today. And — a detail perhaps, but an important one — Barenboim uses it with such careful attention to balance that the bass line, always significant in Mozart's works, neither fades into obscurity nor is treated perfunctorily.

Barenboim offers no formal prettification. All the music is deeply felt and expressed. Some of his tempos are unusual; I found them all completely convincing. Moreover, he uses an orchestra of true Mozartian proportions. In the first movement of the "Paris" the rapidly changing moods are all registered with unfaltering fluency And I find the middle movement, the Andantino, utterly satisfying, too. True he takes the Finale at a much brisker pace than usual, and the orthodox never tire of reminding us that Mozart detested his music being played too fast. Barenboim makes it presto rather than allegro, but he sweeps the listener along with him irresistibly and the E.C.O. get through it without a smudge. Even at Barenboim's pace no note ever treads too closely on the heels of the next, and the phrasing remains intact and elegant.

But it is Barenboim's treatment of the "Jupiter" that will probably cause eyebrows to rise the most. His only consideration seems to have been to have the music played exactly as he thinks it should sound and to the devil with tradition. But whatever you may think of a moment here and there in the first movement, the slow movement will be a joy to all but the most prejudiced; and the Minuet gets up on to its points to dance. The monumental Finale is, to express its appeal to myself in one word — magnificent. By the way, have you ever noticed that the first four notes of the fugal passage — C, D, F, E — are the key signatures of the four Brahms symphonies in their chronological order? I wonder if this was accidental. At any rate, summing up these two performances I must repeat that, if you are prepared to accept readings that do not slavishly follow tradition, they will certainly be for you. And the sound is perfect too.

★ ★ ★

MONTEVERDI — Madrigals and Other Vocal Works. Ilse Wolf; Robert Tear — Berald English; Christopher Keyte; with a section of the English Chamber Orchestra conducted from the Harpsichord by Raymond Leppard. Record Society Stereo NO. S/6326.

It is a pity that this enchanting disc of vocal music is not accompanied by a copy of the texts. In all there are 12 separate items, all of them beguiling, many of them quite disarmingly beautiful. I regret that with the space available to me here it is impossible to list them all. I can however help with a brief outline of what you can hear.

It is all secular, and most of it of the more voluptuous type. Many of the pieces show Monteverdi's unfailing sense of the dramatic when necessary. The works chosen all come from the period 1607-1651. Among the earliest are the now famous Scherzi Musicale, at any rate seven of them. I think you will find their dancing rhythms quite irresistible. Some of the 12 items are for solo voice, others call for two or more singers. All are beautifully sung. And Raymond Leppard makes a contribution of unquestioning value with his harpsicord continuos.

The original disc was issued under the L'Oiseau Lyre label and the sound is consistently first rate. This is a record I can recommend with the heartiest enthusiasm.

(EDITORIAL NOTE. Since this review was set in type we have learned that a text is supplied with this disc, but was apparently not supplied with the review copy.)

★ ★ ★

RAVEL — Bolero; Rapsodie Espagnole; Daphnis et Chloe (Suite No. 2); Pavane pour une Infante Defunte. Orchestre de Paris conducted by Charles Munch. HMV Stereo OASD2497.

So far, the Orchestre de Paris, founded with the blessing of General de Gaulle when he was in power and well advertised as promising great things, has not lived entirely up to expectations in its recordings. I heard the orchestra live under Barbirolli in Strasbourg last year, where they played the first half of the program — a Berlioz overture and the three Debussy Nocturnes — like angels. But in the second half they blared their way into mediocrity in as disappointing a performance of the Brahms Fourth Symphony as I have ever heard. This new disc has its good as well as its commonplace features.

In Bolero, taken slower than usual — no fault this because it gives the single theme a sinuous effect — the side drummer, who repeats the same four bars, the first two slightly different from the third and fourth, during the whole duration of the piece, momentarily loses control of the rhythm, something I've been waiting to happen for years, but hear it for the first time here. But that is its only blemish. Munch makes the Pavane sound more like a lament than a stately dance, though it is most sensitively played in this form, one harmony moving so smoothly into the next that you are almost unaware of the change. It may interest some to learn that the "dead Infanta" words in the title were an afterthought of Ravel's. He was so enamoured of the different French nasal sounds in the words "une Infante Defunte" that he added them to the title Pavane. I think this is the piece in which the Orchestre de Paris can be heard at its best on this new disc.

Both the Rhapsodie Espagnole and the second suite from the ballet Daphnis and Chloe suffer from lack of tension and slackness of propulsion. But another point in this disc's favour is the amount of playing time that is got on to the two sides. This even makes the turnover at the end of the first movement of the Rhapsodie Espagnole quite excusable.

IRELAND — These Things Shall Be, for baritone solo, chorus and orchestra. John Carol Case and the London Philharmonic Orchestra and Chorus conducted by Sir Adrian Boult. Concerto in E Flat Major for Piano and Orchestra. Eric Parkin and the London Philharmonic Orchestra conducted by Sir Adrian Boult. World Record Club S/4668.

A record of John Ireland's music is something of a rarity nowadays and I do not think the choral work, These Things Shall Be, a particularly happy choice for inclusion. The words used by Ireland — a poem by J. A. Symonds — is no better than banal, and the Concerto which is also featured on the disc proves that Ireland had better music in him than you would guess from the choral piece. But whatever the quality of the music the recording is very good indeed, the London Philharmonic Chorus has never sung better, and John Carol Case is fine in the baritone solo. But to me the concerto makes the whole disc worth while even if you never play its coupling. This is Ireland at his best, full of picturesque imagination, technically of unfailing interest, and immediately attractive in its profusion of handsome melodies.

It is admirably played by the LPO under Boult and the playing of the solo part by Eric Parkin is so good that it clamours for more of this splendid pianist's work to be recorded.

* * *

MENDELSSOHN — Symphony No. 5 in D Minor (Reformation).

SCHUBERT — Symphony No. 5 in B Flat Major. New York Philharmonic Orchestra conducted by Leonard Bernstein. CBS Stereo SBR235341.

A new recording of the "Reformation" has long been overdue and it is with pleasure that I can recommend this one. It offers Bernstein in respectful mood. He doesn't destroy the pious atmosphere of the first allegro by indulging in frenzied climaxes, but preserves a respectful spirit of acclamation. The symphony was composed to commemorate the tercentenary of the Augsburg Confession, the official declaration of the Lutheran churches written in 1530. Mendelssohn was only 20 when he composed it. It is also of interest that it makes use for the first time in a composition of any weight of the famous Dresden Amen, later used by Wagner in Parsifal. Remembering the religious origin of the symphony, it is as much at home here as in the music drama.

I was particularly impressed by Bernstein's treatment of the Scherzo which he doesn't make sound too fragile. It remains slightly solemn, thus keeping it within the spirit of the rest of the composition. There is no chasing of a Midsummer Night's Dream Overture atmosphere. Bernstein exercises still more restraint in the lovely slow movement, using it as a prelude to the fine Finale where the true climax of the symphony is to be found. Here again Bernstein makes no attempt to add alien sparkle. His reading has true Lutheran sternness.

There is no lack of good recordings

(Continued on page 190)

CLASSICS ON CASSETTE TAPE

Steadily increasing demand is resulting in a wider repertoire of available classical cassettes, most of them issued by the Philips-DGG group.

But those to whom this — perhaps the handiest form of recorded music ever devised — is new must not expect cassettes to provide truly "hi-fi" reproduction. Connected to a good amplifier and speakers they will give you about the same quality reproduction as a better-class commercial radiogram. This quality has improved since cassettes were first introduced some years ago, much of the background noise has been eliminated, and it is to be expected that still more improvements will be made in the future. In the meantime they provide the handiest way to store and play recorded music. Their future, in my opinion, is now well assured.

★ ★ ★

MOZART — Concerto for Flute, Harp and Orchestra. Hubert Barwahser (flute); Osian Ellis (harp); and the London Symphony Orchestra conducted by Colin Davis. Clarinet Concerto. Jack Brymer (clarinet) and the L.S.O. conducted by Colin Davis. Philips CPC0012.

To get the best result from the first concerto it is advisable to cut your normal bass a little and increase the treble. The balance of the harp suffers from similar prominence as in the disc version, a little too much resonance in the middle register and some weakness at the very top. But this does not prevent admirable reproduction of lovely crystalline sound in the harp part. The flute solo is excellent, and the playing of all concerned, soloists and orchestra, under Davis, is splendid. Notice particularly the beautifully steady flute tone in the slow movement.

In the Clarinet Concerto, keep the treble at the same setting, but set the bass to normal. Brymer gives the most beguiling performance imaginable of the solo part, cooing away with enchanting tone. Tempos are perfect for my taste and the whole performance is in perfect style. Clarinet players will notice that Brymer leads back in the slow movement with a phrase of his own and not with the usual loan from the Clarinet Quintet, with, I think, the happiest of results.

★ ★ ★

PROKOFIEFF — Piano Concerto No. 3 in C Major.

RAVEL — Piano Concerto in G Major. Martha Argerich and the Berlin Philharmonic Orchestra conducted by Claudio Abbado. DGG 923040.

I have never come across these two excellent performances in disc form. Also it is my first meeting with the solo pianist, Martha Argerich, who, judging by her photograph on the cassette container, is as handsome as her playing. Again you will find a longer than usual reverberation period, but not protracted enough to cause any serious worry. I hope I will not be thought patronising when I say that I would never have picked Miss Argerich's playing as a woman's. The forceful authority of her fast passages is matched by the sensitivity of the more delicate ones. She has, moreover, a range of sonorities that even the late Walter Gieseking might well have admired. Notice particularly the delicate perception of her handling of the long Bach-like aria in the slow movement of the Ravel and in the following figurations. Everywhere she is treated like an equal by the orchestra and conductor.

Her reading of the Prokofieff is essentially romantic when the percussive approach of most other pianists is recalled. I don't mean by this that you will hear any wilful distortions and alien rubatos. Every note has gem-like separation and in the first movement this produces sparkle without pugnacity. In both concertos Miss Argerich displays a very wide dynamic range, always under unshakeable control. Very strongly recommended.

★ ★ ★

BRAHMS — Violin Concerto in D Major. Arthur Grumiaux and the Concertgebouw Orchestra conducted by Eduard van Beinum.

BEETHOVEN — Violin Romance No. 1 in G Major. Same performers conducted by Bernard Haitink. Philips CPC0013 (05).

This makes an interesting cassette to compare with the previous one because of the thicker quality of Brahms' scoring. The cassette must have been made from a fairly old recording because van Beinum has been dead some years now. But it carries its age very well indeed so far as recording quality is concerned. Compared to the unremitting drive most great violinists bring to this concerto Grumiaux's reading is beautifully lyrical with quite heavenly moments in such passages as the one just before the end of the first movement where Brahms is at his most feminine. But good as the performance is, I think it might be worth while waiting until another of equal merit but more modern in recording technique becomes available. Myself, I'm quite happy with it. Grumiaux's is the sweetest interpretation of this heavyweight concerto I have ever heard.

The Beethoven Romance is of much more recent origin and can be recommended without any of the technical qualifications mentioned above.

★ ★ ★

VIVALDI — The Four Seasons. I Musici. Philips CPC0002.

The sound here is excellent. It has admirable clarity with a wide range of frequencies and dynamics. This early eighteenth century music, as played by I Musici, is perennially fresh; and this distinguished group are at once alert and poetic. The only minor criticism I can make of this first rate issue is that I would have liked to hear a little more of the harpsichord continuo. Otherwise even the most carping of critics will find themselves in for a very pleasant experience.

★ ★ ★

MOZART—Piano Concertos Nos. 12 in A Major and 16 in D Major (K.414 and 451). Geza Anda and the Camerata Academica des Salzburger Mozarteums conducted by Geza Anda at the piano. DGG932005.

The sound in this at normal setting is a wee bit plummy but can be considerably improved by a hefty treble boost. The playing in both concertos is in what has become to be recognised as orthodox Mozartian style — smooth, never too heavy, and concentration on clarity of line and unemphasised inflections. If you make allowances for the small matters mentioned above you should find this cassette eminently acceptable.

★ ★ ★

MENDELSSOHN — Symphony No. 4 In A Major (The Italian). Symphony No. 5 in D Major (The Reformation). Berlin Philharmonic Orchestra conducted by Lorin Maazel. DGG923013.

After the brilliance of the sound in the previously reviewed cassette (The Four Seasons), it is noticeable that this one lacks something in the way of high frequencies. But I found my ear soon adjusted itself to their absence. Maazel attacks the first movement of the "Italian" with great spirit and despite its speed manages to win perfect articulation and phrasing. It is all most exhilarating, approached in precision only by the Cleveland under Szell. Maazel doesn't dawdle over the "Pilgrims' March" in the second movement and the following minuet is as graceful as anything he has ever conducted. At one spot the woodwind fairly gurgles with delight. Yet all is handled with smiling restraint. The sparkling "Neapolitan" Final goes with even more elan than the first movement without any sign of a scramble. Breathtaking perfection of performance.

The "Reformation" is a much more austere work without the exuberance of the "Italian." It was interesting to compare Maazel's reading on this cassette to Bernstein's disc reviewed in the classical record section this month. Although there are minor differences of interpretation both conductors achieve solemnity without pompousness. Surprisingly — at any rate, to me — Maazel's is the more romantically handled. He doesn't seem to be watching himself so carefully as Bernstein and abandons himself without reserve to the delights of the dancing second movement. The tonal quality of the Maazel is a trifle woolly at times and in the Finale sounds slightly overloaded. But whatever details you may find to criticise in the "Reformation" I can guarantee your complete satisfaction with the "Italian."

MA75
Top of the BSR range. Features 11" die-cast turntable and clip-in cartridge holder.

MA70
Favourite of sound enthusiasts all over the world.

MA65
Engineered to the same high standards as the others and incorporating many of their features.

MA55
The BSR MA55 provides an economical unit packed with BSR features.

4 GREAT BSR TURNTABLE UNITS

MODEL	TURNTABLE 11" dia. Pressed	Cast	MOTOR 2 Pole	4 Pole	POWER SUPPLY 240V 50 cycle	Dual Voltage	PICK-UP ARM Low Mass Tubular aluminium	Counterbalanced	Cue/Pause Lever	Automatic lock	Bias compensator	Stylus pressure Adjuster	Calibrated Stylus pressure Control	Muting Switch	SWITCH 'POP' FILTER	STUB SUPPLIED	RECORD CAPACITY	TURNTABLE SPEED	CARTRIDGES
MA75		•		•	•	•	•	•	•	•	•	•	•	•	•	•	Up to eight 7", 10" or 12" diameter records with manual selection of record size.	16, 33, 45, 78 r.p.m.	Any Standard mono or stereo cartridge can be fitted.
MA70	•			•	•	•	•	•	•	•	•	•	•			•			
MA65	•		•		•		•		•	•	•	•				•			
MA55	•		•		•		•				•	•							

BSR (A'Asia) Pty. Ltd.
Monarch Works Industrial Estate.
St. Marys N.S.W.
Phone: 623-0375

WHOLESALE DISTRIBUTORS
Goldring Engineering (A'Asia) Pty. Ltd.,
N.S.W.: 443 Kent St., Sydney, 2000. 29-1275
VIC.: 162 Pelham St., Carlton, Vic. 3053. 67-1197
QLD.: 415 Adelaide St., Brisbane, Qld. 4000. 2-3247
W.A.: 32 Northwood St., Perth, W.A. 6007. 8-4988
S.A.: 77 Wright St., Adelaide, 5000. 51-5117

BSR:P106

Model 500 with ceramic cartridge . . . $103
Model 500 with 800H Magnetic cartridge . . . $114
Model 600 with CI/ST4 cartridge . . . $114
Model 600 with 800H Magnetic cartridge . . . $125

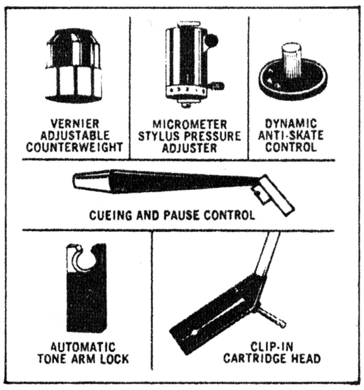
The only triple tested total turntables. BSR McDonald.

Every BSR McDonald automatic turntable is precision made and tested in Great Britain to the most exacting specification. Upon arrival in Australia, every model is unpacked, tested and assembled in the total turntable concept, then re-tested again under actual playing conditions. That's why BSR service calls are the lowest in the industry – and perhaps that also explains why BSR sells more turntables than anyone else in the world.

The BSR McDonald 500 and 600 are complete modular units ready for use. Each unit has an ebony polystyrene base, smoke tinted dust cover, mains and audio leads – the only complete, packaged, factory tested units.

Features such as

- Dynamic anti-skate control applies continuously corrected compensation at all groove diameters.
- Cueing and pause control lever allows for exact positioning of stylus on record and permits you to interrupt listening and reposition to same groove.
- Micrometer stylus pressure adjustment permits 1/3 gram settings from 0 to 6 grams.
- Automatic lock on tone arm after last record is played.
- Dynamically balanced 4-pole induction motor has high torque, constant speed design – assuring minimum rumble and row.
- Tubular aluminium tone arm is perfectly counter-balanced both horizontally and vertically.
- Resiliently mounted, coarse and fine vernier adjustable counterweight.
- Tone arm is jam-proof even if it is held during the cycling operation.
- Clip-in cartridge holder, provides universal mounting and quick change. (Optional).



BSR A'Asia Pty Ltd
Southern Section Industrial Estate
St Marys New South Wales
Telephones 6230375 and 6230376

Wholesale Distributors Goldring Engineering (A'Asia) Pty Ltd **New South Wales** 443 Kent Street Sydney 2000 Telephone 29-5802/3/4 **Victoria** 162 Pelham Street Carlton 3053 Telephone 34-5105 **Queensland** 415 Adelaide Street Brisbane 4000 Telephone 2-3247 **Western Australia** 32 Northwood Street Leederville 6007 Telephone 84-988 **South Australia** 77 Wright Street Adelaide 5000 Telephone 51-5117

BSR:P 104

VARIETY FAIR

By HARRY TYRER, FORBES CAMERON, NEVILLE WILLIAMS

Devotional recordings

THE GLORY OF GABRIELLI, Vol. III (Music for A Capella Choir). C.B.S. (Australian Record Company) stereo SBR 235349.

Interest: Renaissance music of the Catholic Church.
Performance: Outstanding.
Quality: Well recorded.
Stereo: Well spread.

The idea of recording Gabrielli's music for unaccompanied choir (a capella) in the environment where it was written and first performed was apparently not for reasons of sentiment or affectation. Gregg Smith, the musical director of this group, believes that it can only sound natural under these circumstances — and who will dispute the issue with him after hearing these glorious performances: Admittedly the all professional choir is technically excellent, but the wonderful acoustic atmosphere in this recording leaves no doubt in my mind that Greg Smith is entirely right in his suppositions.

Gabrielli was a church composer, and wrote mainly music for church performances. Most of the items here are liturgical, comprising: Deus, in Nomine Tuo (from Psalm 53)—Beata es, Virgo Maria (Antiphon for the Magnificat—Jubilemus Singuli (Hymn to St. Mark)—Deus, Deus Meus (from Psalm 62)—O Quam Suavis Est (Antiphon for the Magnificat) — A Capella Mass: Kyrie, Sanctus; Benedictus—Cantate Domino (Psalm 95)—Domine Exaudi (Psalm 101)—Hodie Completi (Antiphon for the Magnificat). Listening to this glorious music sung so expertly was a moving experience for me, as I am sure it will be to anybody who has any acquaintance with the music of the Catholic Church, or anybody else, for that matter, who appreciates fine singing of liturgical works. (H.A.T.)

★ ★ ★

AMEN, The 130-voice Choir and Choral of the First Baptist Church of Van Nuys, California, directed by John Gustafson. Stereo, Light, LS-5505-LP. (From Sacred Productions Aust., 181 Clarence St, Sydney, and other capital cities.)

Interest: Hollywood-style choir.
Performance: Excellent in its class.
Quality: Good.
Stereo: Normal.

Air-conditioning and plenty of reticulated water have transformed the hot and dry San Fernando Valley into a fashionable residential area, away from the coastal smog of Hollywood and Los Angeles. The First Baptist Church of Van Nuys would appear to reflect the prosperity of the community with its 8,000 members, 31 choral groups, involving 1,300 singers and, at the head of it all, that very accomplished Gospel musician, John Gustafson.

From this background one would not expect to hear anything but the best and, in fact, solo voices, massed voices, and orchestral voices combine to present a highly polished performance. But, as noted above, there is a dramatic, all-American quality about the presentation that some will relish and others will dislike. One almost looks for the screen and the climactic ending to match the sound that issues from the stereo loudspeakers.

The titles: Amen —Rock Of Ages — All Hail The Power — Oh For A Thousand Tongues To Sing — The Old Rugged Cross — Peace In The Valley — America The Beautiful — I want to Be Ready — It Is No Secret — Jacob's Ladder — Take My Hand Precious Lord — Amazing Grace.

A very well produced record in its class but one that would not necessarily please those with more conservative ideas of choral music. (W.N.W.)

★ ★ ★

SACRED SONGS. June Bronhill with the John McCarthy Singers. Organist Brian Stanborough. Conducted by John McCarthy. Stereo, Columbia SCXO-6359.

Interest: Well known singer, music.
Performance: Thoroughly enjoyable.
Quality: Excellent.
Stereo: Normal.

June Gough, whose stage name is a constant reminder of her home town, Broken Hill, N.S.W., has enjoyed considerable success in England, Australia nad South Africa. Her stage successes have included "Merry Widow," "Robert and Elizabeth," "The Dancing Years" and "Sound Of Music."

Here, with the John McCarthy Singers, she presents a generous 50-minute program of well known sacred songs, which should find plenty of ready buyers: Nuns' Chorus — Flocks In Pastures Green Abiding—Easter Hymn — Ave Maria — O For The Wings Of A Dove — Nearer My God To Thee — Bless This House — Largo — Agnus Dei — The Holy City — O Divine Redeemer — Abide With Me.

The soloist's diction and phrasing are excellent, likewise the arrangements and backing, while those with an ear for the pipe organ will enjoy the work of Brian Stanborough. A record you can buy with confidence. (W.N.W.)

★ ★ ★

MARCY SINGS "Jesus Loves Me" and Fourteen Other Songs. Mono, Word K-704. (Available from Sacred Productions Aust., 181 Clarence Street, Sydney and other capitals).

Interest: Very, very young children.
Performance: Unique.
Quality: Excellent.

To say I was surprised, when I put this album on the turntable, would be to put it mildly. The portrait on the cover is that of a mature woman, Marcy Tigner, but the voice that emerges from the loudspeaker is that of a little child, with child-like pronunciation and the child-like struggle to reach notes which are just beyond its register.

The paradox is explained by the jacket notes which indicate that Marcy Tigner is a musician and ventriloquist and that the voice is supposed to belong to a little girl doll, which is featured regularly on U.S. television and radio.

The fourteen hymns and choruses are well known and typical of those which would be enjoyed by children in Sunday School kindergarten departments. And this, I imagine, would be

the natural place where the record could be put to best use. Either that, or in homes where there are small children who have been taught these particular hymns and choruses. But I wouldn't recommend it for general listening. The price, by the way, is $2.50 (W.N.W.)

Instrumental, Vocal and Humour . . .

POPULAR STRING MUSIC, conducted by Sir Malcolm Sargent, with the Royal Philharmonic Orchestra. World Record Club stereo S/4614.

Interest: Tuneful classics.
Performance: Hard to fault.
Quality: Good.
Stereo: Limited spread.

This disc gave me a session of pure delight from start to finish. It is virtually pure melody all through, and beautifully played by the strings of the Royal Philharmonic Orchestra under the baton of the late Sir Malcolm Sargent. The Dvorak "Serenade for Strings" (op. 22, in E major) is one of that composer's happiest inspirations, written at a time when he was experiencing the first flush of success. Its glowing beauty has ensured its success with concertgoers (and record buyers) in all parts of the world. This is followed by Peter Warlock's "Capriol" Suite, a set of charming miniatures based on ancient dance pieces. Although written as late as 1926 it has no trace of the aggressive modernism which was sweeping the world of music at the time. Finally, there is Gustav Holst's popular "St. Paul's Suite," written in 1913 for performance by pupils of the St. Paul's Girls' School where he taught music for a large part of his life. It has been a firm favourite ever since he published a version for string orchestra. The last movement is perhaps best known, its popularity being due to the inclusion of the familiar "Greensleeves" melody.

The recording quality is adequate, the sound being clean and bright, but dynamic range is not wide. The stereo spread is even but slightly restricted. All in all, a "safe" record which should have wide appeal. (H.A.T.)

★ ★ ★

THE ENJOYMENT OF OPERA, Vol. 1. Various artists and orchestras. His Master's Voice. Stereo SOELP 9588.

Interest: Opera sampler.
Performance: Top ranking artists.
Quality: Good throughout.
Stereo: Some variation.

Recently I reviewed "The Enjoyment of Music" in the same series, and gave it the strongest possible recommendation. I was therefore delighted to receive this, which I took to be a companion disc. However, it appears that this disc (and presumably volume 2 to follow) has a rather more definite purpose in mind than the earlier release. The sleeve note reveals that the disc was prepared to provide sound illustrations for the book by Alan Blythe, also called "The Enjoyment of Opera" (Oxford University Press). "Most items are specifically referred to in the book"

we are told. This accounts for some of the rather unusual selections to be found here, such as the recitative secco (i.e., without orchestra) "Per Carita" from "Cosi Fan Tutti," and the flamenco section of "La Vida Breve."

Space does not allow a full listing of the items and artists included, but here is a rundown of the work represented and the heading under which they appear: Costi Fan Tutti (recitative secco) —Dido and Aneas (accompanied recitative) — Otello (seamless music drama) — Boris Godounov (expression of feeling) — The Flying Dutchman (duet) — Fidelio (quartet) — Aida (big ensemble) — Il Seraglio (comedy of character) — Falstaff (comedy of situation) — Don Pasquale; Les Troyens a Carthage; Tristan and Isolda (love duets) — Der Freischutz; A Life for the Tsar; The Bartered Bride; La Vida Breve (romanticism and nationalism). These extracts are all from top ranking performances in the E.M.I. catalogue, featuring exclusively world famous artists. As such, the disc represents wonderful value at $2.50, and is another superb public relations exercise by the E.M.I. organisation. (H.A.T.)

★ ★ ★

STRAUSS WALTZES OF VIENNA. Royal Philharmonic Orchestra, conducted by Sir Malcolm Sargent. Music for Pleasure, compatible stereo MFP-A9031.

Interest: Viennese waltzes.
Performance: Unrelaxed.
Quality: Dated.
Stereo: Restricted.

Apart from its low-price tag, there is very little one can say in favour of this disc. Even then, one has to bear in mind the numerous excellent recordings of the music of Strauss reviewed in these columns in recent issues, on low price labels. Here, the orchestra sounds very stiff, and self-conscious, and do not appear to be enjoying the experience one bit. The sound quality is dated, and the restricted dynamic range is very noticeable. To cap it all, the playing time is by no means generous. Only five items are included: Tales of the Vienna Woods — Emperor Waltz — Blue Danube Waltz — Wine, Women and Song — Artist's Life. I cannot really recommend this one, even at the low price. (H.A.T.).

★ ★ ★

MANUEL AND THE MUSIC OF THE MASTERS. Manuel and his Orchestra. Studio 2, Stereo (E.M.I.) TWO 284.

Interest: Light orchestral.
Performance: Very pleasing.
Quality: Excellent.
Stereo: Very noticeable.

For those with a taste for Palm Court style music, here is an example par excellence which cannot fail to please. This group has previously been featured as Manuel and his Music of the Mountains, and I am glad to see this appellation has been dropped, since it tends to be misleading. The faintly hillbilly air of the title certainly does not do justice to the excellence of their playing. Apart from the high standard of musicianship, I must comment on the skill of the arranger, credited in the titles simply as "Love." The labours of Love in this selection have resulted in some very pleasing tracks, and in particular I was impressed by his treatment of the Adagio Cantabile move-

ment from Beethoven's "Pathetique" sonata. This is the only satisfactory arrangement of this piece for orchestra I have encountered in many years of listening. Some of the other arrangements are almost equally successful.

The selection comprises: Sonata Pathetique, slow movement (Beethoven) — Etude, Op. 10, No. 3 "Tristesse" (Chopin) —Barcarolle (Offenbach) — Liebestraum (Liszt) — Waltz from "Serenade for Strings" (Tchaikowsky)— Prelude to Act III from "La Traviata" (Verdi) — Chanson Triste (Tchaikowsky) — Andante Cantabile (Tchaikowsky) — Largo (Handel) — Humming Chorus from "Madame Butterfly" (Puccini). The last item reminds me that a humming chorus is featured in several tracks to good effect. (H.A.T.).

★ ★ ★

WHIRLWIND OF WALTZES. Raymond Lefevre and his Orchestra. Riviera (Festival), Stereo SRVL-933,259.

Interest: Short form Strauss.
Performance: Pleasing style.
Quality: Very good.
Stereo: Normal.

Strauss waltzes come in two sizes — the full length version complete with preludes and postludes, as favoured by full symphony orchestras, and the shortened versions for light orchestra performance, playing the main themes only, often without repeats. As there are no less than 12 Strauss waltzes here it is not surprising to find they are the shortened versions. The results are pleasing enough, nicely played by a largish light orchestra, and skilfully arranged, so if you find the full-dress versions overlong, as some people apparently do, this could be to your taste. All the best-known Strauss waltzes are there: Voices Of Spring, Blue Danube, Vienna Woods, Treasure, Roses of the South — need I go on? The Riviera label is one I have not previously encountered, and is presumably a new one in Australia. Technically, it is entirely satisfactory. (H.A.T.).

★ ★ ★

GREAT LOVE FILM THEMES. Various orchestras. Universal Record Club. Stereo U-1033.

Interest: Film music.
Performance: High standard.
Quality: Excellent.
Stereo: Normal.

Some of the best modern film themes are included in this selection, mostly represented by original sound track music or by an orchestra using the original film score. The rest are from United Artist's records of recent vintage. Whatever the source, the playing is of high standard throughout. From the original sound track are themes from: Irma la Douce — A Man and a Woman — Modern Times — Goodbye Again — Phaedra — Tom Jones. Original scores are used for: The Thomas Crown Affair — Fitzwilly Strikes Back — Hawaii. Duo pianists Ferrante and Teicher, with orchestral backing, contribute two tracks in their usual polished style: Love Is a Many Splendoured Thing — A Summer Place. The very generous helping of 14 tracks is completed by: Moon River (Breakfast at Tiffany's) — To Sir with Love—Love Theme from Romeo and Juliet. The sound quality is excellent throughout, and even the music from the 1936 "Limelight" sound remarkably good for its age. (H.A.T.)

★ ★ ★

ALOHA HAWAII. The Waikiki Beach Boys. Stereo, Music For Pleasure. MFP-A 8109.

Interest: Happy island sound.
Performance: Bright.
Quality: Good.
Stereo: Plenty of separation.

Island music seems to have its own relaxing charm, whether played by three or four native musicians or by a larger group in a strictly commercial environment. The Waikiki boys make free use of an organ and other electronic aids, and their tempi are even and danceable, but the sound, as I said, is pleasant and relaxing. They play: Tiger Shark — Beyond The Rainbow — Sophisticated Hula — Pearly Shells —Little Heaven of the Seven Seas— Hawaiian Cha Cha — Sarawaki — Ua Like No A Like — Little Brown Girl — Blue Tahitian Moon — The Hukilou Song — Aloha Oe. Playing time is about 40 minutes.

Excellent value if you like island music. (W.N.W.)

★ ★ ★

JOE LOSS PLAYS GLENN MILLER. Music For Pleasure. Stereo MFP-A 8092.

Interest: Faithful recreations.
Performance: Well played.
Quality: Bright recording.
Stereo: Normal separation.

The music of Glen Miller is currently at a peak of popularity in England, mainly through the untiring devotion of the Syd Lawrence Orchestra. In addition, the Glen Miller Orchestra, as such, still functions successfully in America.

This LP is a further contribution to the continuing legend of Glenn Miller, with English bandleader Joe Loss leading his Orchestra through twelve of Miller's most popular numbers.

They include, for example, "Moonlight Serenade," "American Patrol," "Little Brown Jug," "Tuxedo Junction" and "String of Pearls." The arrangements are faithful to Miller, the vocals are competent and the Joe Loss Orchestra is a well-drilled, efficient dance band.

Nostalgic lovers of Glen Miller's musim may find the L.P. appealing, particularly at the MFP budget-price of $1.99. In the final analysis, however, recreations are a poor substitute for the original. (T.F.C.)

★ ★ ★

YE-ME-LE. Sergio Mendes and Brasil '66. A. & M. Records (Festival) stereo SAML-933,614. Available in mono.

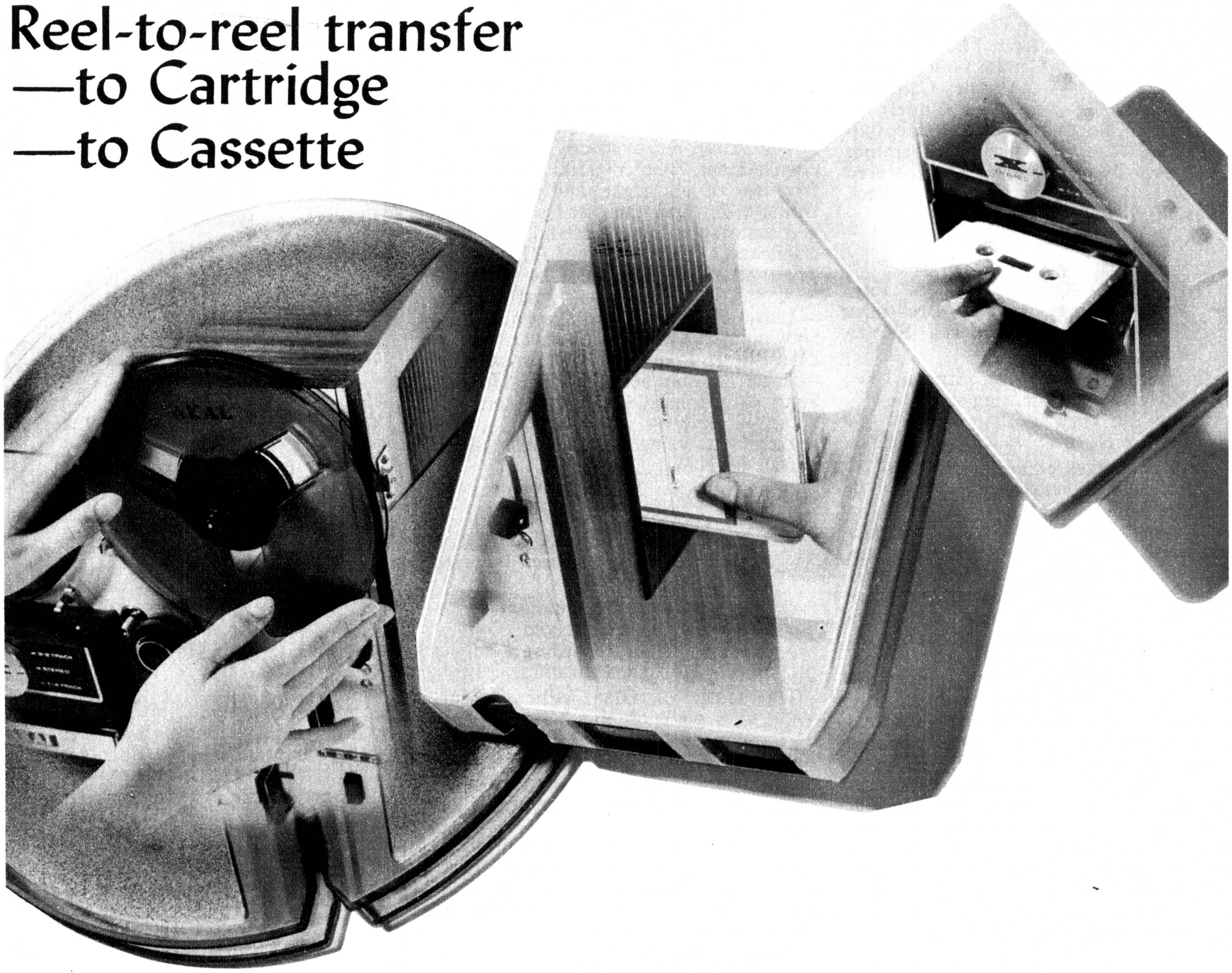
Interest: Bossa Nova.
Performance: See review.
Quality: Excellent.
Stereo: Three-channel type.

Record critics have been complaining for some time that the cool and elegant lead singer of this group, Lani Hall, has not been accorded enough recognition for the major contribution she makes to its success. Here, for the first time, she is allowed to dominate in some tracks, instead of being held in a sup

TRANSFER WITH AKAI!

Newest stereo sensation

Reel-to-reel transfer
—to Cartridge
—to Cassette



Only AKAI has been able to combine the best stereo component features into one remarkable instrument to bring you an open reel, cartridge and cassette tape recorder. AKAI's **X-2000SD** provides the easy-to-operate transfer advantages of reel-to-reel, reel to cartridge and reel to cassette.

1. Reel-to-reel—4 track stereo/monaural recording and playback with AKAI's own unique CROSS-FIELD HEAD. (Also selector. Tape lifter.)
2. Cartridge—8 track stereo recording and playback with a one-micron gap head. 1 hour continuous performance. Program indicator lamp.
3. Cassette—4 track stereo recording and playback with a one-micron gap head, panel push-button controls, 1 hour continuous performance. Don't miss AKAI's once-in-a-lifetime exculusive tape recorder.

Prove it by the sound!
...........prove it with **AKAI**®

NEW **Model X-2000SD**

AKAI AUSTRALIA PTY. LTD.: 276 Castlereagh St., Sydney, N.S.W. Tel: 61-9881/146 Burwood Rd., Hawthorn, VICTORIA Tel: 81-0574/399 Montague Rd., West End, Brisbane, QUEENSLAND Tel: 4-0171/8 Arthur St., Unley, S.A. Tel: 71-1162/579 Murray St., Perth, W.A. Tel: 21-2561 **SONNY COHEN & SON:** 20 Isa St., Fyshwick, A.C.T. Tel: 9-1551 **WILLS & CO., PTY., LTD.:** 7 Quadrant, Lauceston, Tasmania Tel: 2-4641

porting role for the instrumentals, with her partner. This has tended to have a significant effect on the group's style, and I am not at all sure that this change is for the better. Buyers of this record will be able to make their own decision in the matter, as in more than half the tracks the earlier technique is maintained. Track titles are: Wichita Linesman — Norwegian Wood — Some Time Ago — Moanin' — Look Who's Mine—Ye-Me-Le—Easy To Be Hard — Where Are You Coming From? — Masquerade — What the World Needs Now. (H.A.T.).

★ ★ ★

AMOR MEXICO/S.A. Tony Mottola, guitar, with orchestra. Stateside (E.M.I.) stereo SOSL-10060.

Interest: Spanish/L.A. tunes.
Performance: Mellow, relaxed.
Quality: Excellent.
Stereo: Good spread.

This is a re-issue on the Stateside label of one of the excellent Enoch Light/Command discs of a few years ago. In fact, this disc is dated by the "Tijuana Taxi" track, with its frank imitation of the Tijuana Brass style — I think it is correct to assume that it appeared when the Herb Alpert group was at the peak of its popularity. Also in the selection are: La Raspa — Quando Vuelva a Tu Lado — Vaya Con Dios — Peligro Bossa Nova — Baile de Venezuela — Baia — Cavaquinho — Cuando Caliente el Sol — La Mentira — Recado Bossa Nova — Yo Te Amo.

Splendid support from Mottola's lyrical guitar playing is provided by artists of the calibre of Doc Severinsen, trumpet; Dom Cortese, accordion; Phil Kraus, marimba; Al Casamenti, rhythm guitar; Bob Haggart, bass; and Bobby Rosengarden, drums. With such a line-up of talent, the results can hardly fail to be entirely satisfying. The tunes are good, the arrangements are first class and sound quality is excellent. What more can you ask? (H.A.T.).

★ ★ ★

MIDNIGHT COWBOY. Ferrante and Teicher, with orchestra and chorus conducted by Nick Perito. United Artists (Festival) stereo SUAL-933,604. Available in mono.

Interest: Piano duo.
Performance: Slickly commercial.
Quality: Excellent.
Stereo: Normal.

There are no gimmicks about piano duettists Ferrante and Teicher. The material they play is either firmly established current hits or popular evergreens; their arrangements are straightforward no-nonsense affairs; the supporting artists are good studio musicians, whose function is to provide soft harmonies behind the twin pianos, and carry the melody when the pianos are silent; and their piano work is slick, smooth and uncomplicated. All this may not sound very enterprising, but it has apparently paid off, judging by the regularity of their releases. If you like their style, this newest release is as good as any of their earlier efforts I have heard. Included are: Midnight Cowboy — Little Green Apples — Aquarius — Scarborough Fair—Popi — Love's Old Sweet Song — Gentle On My Mind — The Windmills of Your Mind — Those Were the Days — The Sound of Silence — My Way — Rock-A-Bye-Baby. The technical side of the disc is of excellent standard. (H.A.T.).

★ ★ ★

A TAVERN IN THE TOWN. The Honky Tonk Piano of Bobby Allen. Compatible stereo, Music For Pleasure MFP-A8098.

Interest: Old timers.
Performance: Mainly strict tempo.
Quality: Good.
Stereo: Adequate.

If you're greying around the temples, you'll almost certainly enjoy this line-up of oldies: South Of The Border — Nellie Dean — There's A Tavern In The Town — Galway Bay — Ain't She Sweet — Walking My Baby Back Home — On Mother Kelly's Doorstep — The White Cliffs Of Dover — When The Red, Red Robin — It's A Sin To Tell A Lie — Annie Laurie — Now Is The Hour.

So much for the numbers. How much you actually enjoy them will depend on your reaction to the honky-tonk piano. If you like it, you'll enjoy Bobby Allen's performance; if you aren't too keen on the mistuned strings, the slower numbers will give you more than the usual time to contemplate the twang!

But, once again, if the music appeals, the MFP price and 35-plus minutes of playing time make this good value. (W.N.W.)

★ ★ ★

THE GOLDEN AGE OF SONG. Various artists. His Master's Voice (E.M.I.) mono OXLP 7524.

Interest: Tuneful arias and songs.
Performance: The best.
Quality: Well remastered.

Do you remember, before the LP era, that if you wanted Saint-Saens' "Softly Awakes My Heart" you did not have to wonder which of dozens of versions you should choose? — Marian Anderson's version was the automatic choice from the few available. Or "A Bachelor Gay" from "Maid of the Mountains"?; Peter Dawson, of course. Then there was "The Holy City," and you did not have to look beyond the Richard Crook recording. These and others of the same category, the standards of their time, make up the ten tracks of this enjoyable disc. The others are: E Lucevan le Stelle from "Tosca" (sung by Giuseppe de Stefano); Letter Scene and Waltz from "Der Rosenkavalier" (Alexander Kipnis and Else Ruziczka); Gendarmes Duet from Offenbach's "Genevieve de Brabant" (Malcolm McEachern and Harold Williams); Funiculi-Funicula (Miliza Korjus); Santa Lucia (Luigi Infantino); Wer Uns Getraut from "The Gipsy Baron" (Herbert Ernst Groh and Emmy Bettendorf); Gluck Das Mir Verlieb, from Korngold's "The Dead City."

A delightful selection of tunes, wonderfully sung in every track. In fact, I should say that here there is virtual perfection in every sense except one — the sound quality of the old 78rpm discs from which the tracks are taken. Yet even this is surprisingly good, since the tracks have been expertly remastered, and there is virtually no residual surface noise. If you can answer the first question posed above in the affirmative, you will find much to delight you in this disc. The price, by the way, is only $3.65. (H.A.T.)

Is it possible for all these features to be concentrated in ONE turntable?

LABCRAFT MODEL 605 L WITH THE B & O ST/L 15° ARM

Yes, LABCRAFT has them all!

A highly advanced transcription turntable with professional wow, flutter and rumble specifications. The Labcraft ranks amongst the world's top semi-professional turntables; wow and flutter <0.15% peak, rumble 35 db below reference level at 1.4 cm/100cs. The Labcraft is designed for the exacting audiophile who insists on highest quality in performance and design. Its unique construction with several exclusive features insures faultless operation and reduces service to practically nought.

- Belt drive from patented motor suspension which isolates all vibration from base plate, arm and turntable.
- Functions perfectly — "rumble", "wow" and "flutter" completely eliminated.
- Outstanding Danish design produced under strict quality control: every turntable individually test-run and carefully checked before leaving the factory.
- Drive spindle ground and polished to extremely fine tolerances. (0.000,04").
- Fully shielded motor, (windings "potted" in epoxy resin), placed at left rear corner enabling use of the very lowest level unshielded magnetic pickups.
- The turntable is provided with nylon and bronze bearings. These are self-lubricating and no lubrication should ever be necessary.
- The speed can be adjusted manually. The asynchronous motor (not tied to mains frequency) has a special governor independent of mains voltage and frequency.
- Stroboscope lines are moulded in the turntable mat for a guide in speed adjustment.
- Base plate ready drilled to take "All Balance" or "B & O" pickup arms.
- Motor fitted with special secondary winding providing a free source of 15 volts A.C. supply for powering a transistorised pre-amplifier.
- Pickup arm rest with built-in start/stop switch.
- Accessories include ash, teak or palisander base, plastic cover, lightweight metal arm, oil damp arm lowering device, automatic off-switch, solid state stereo pre-amplifier.

NOW BIGGER AND BETTER THAN EVER BEFORE!

Danish Hi-Fi Pty. Ltd.

For Highest Quality Audio Equipment visit our new showrooms at:

698 BURKE ROAD, CAMBERWELL, VIC. 3124. PHONE: 82 4839

131 EXHIBITION ST., SOUTHERN CROSS HOTEL, LOWER PLAZA SHOP No. 9, MELBOURNE. PHONE: 63 8930

THE FOOL ON THE HILL — George Shearing. Capitol (EMI) Stereo ST 181.

Interest: Mainly quartet.
Performance: Pleasant.
Quality: Flat recording.
Stereo: Well balanced.

It is many years since English-born pianist, George Shearing, made a jazz album but it should be said that, in his day, few pianists could match his superb playing. It is inevitable, but none the less regrettable, that Shearing should feel obliged to concentrate on mood-music albums.

This most recent Shearing LP provides easy and relaxed listening, however. All eleven tracks are Latin-flavoured and in some, Shearing augments his quartet and quintet with Latin/American percussion.

Most of the songs are familiar and include Cole Porter's "Easy To Love" and "I Concentrate On You," Lennon/McCartney's "Fool On The Hill" and Burt Bacharach's "Promises," one Shearing original called "Simple Sideman," and three Jobim compositions, "Wave," "Meditation" and "Favela."

The music on this album, therefore, lacks substance but it is polished, pleasant and well played — ideal, in short, for late-night listening. But the playing-time of 29 minutes is grossly inadequate. (T.F.C.)

★ ★ ★

THE BEST OF THE KINGSTON TRIO. Capitol (E.M.I.) stereo SENC 9566. (Price $2.50)

Interest: Folk group.
Performance: Good entertainment.
Quality: Good standard.
Stereo: Normal.

Despite their retirement from active recording several years ago, the Kingston Trio have remained popular. This $2.50 disc, which claims to be their best tracks, should therefore entice a lot of folk music enthusiasts. One might have other ideas about which tracks should be included under this title, but what the heck . . . somebody thought these were the group's best tracks, so they should have something. Certainly "Tom Dooley" which starts side one, and their version of "Where Have All the Flowers Gone" on side 2 were received with rapture whenever they performed live. Also included are: The Tijuana Jail — Scotch and Soda — Bad Man's Blunder — Raspberries, Strawberries — Everglades —M.T.A. — The Merry Minuet — Billy Goat Hill — Take Her Out of Pity — A Worried Man. I personally would not have included some of these in my selection for the group's best tracks, but still I found this a very enjoyable recording by three fine artists. (H.A.T.)

★ ★ ★

AN EVENING AT THE COSTA BRAVA. Various artists. Decca (E.M.I.) stereo SKLA 7659.

Interest: Popular Spanish numbers.
Quality: Excellent.
Stereo: Normal.

The Costa Brava is a popular Spanish holiday resort on the Mediterranean sea, but this is not the Costa Brava meant here. I assume the locale is a German night spot which features Spanish-style entertainment, since the recording was made in Germany, and the orchestra has the unlikely name of "Das Orchester Charles Parker." While one might be inclined to suspect the Spanish origins of the orchestra, the artists who appear with it do not come into question. There is a pair of guitar-strumming male vocalists called Los Verde. Luna (The Green Moons) who provide very pleasant sounding versions of "Cucurucucu" and "Mexico"; a guitar virtuoso called Eddie Pequenino who contributes sparkling accounts of "Mambo Boracho," "Las Muchachas" and "El Toro y la Luna"; a delightful female vocalist called Luisa Linares with a backing group called Los Galindos who contribute "Linda es Mi Tierra" and "Rosita Donde Eastas."

The orchestra itself provides splendidly vigorous versions of the following Spanish bullring standards: Espana Cani — La Cumparsita — Spanish Eyes — El Gato Montes — Mexican Hat Dance. I thoroughly enjoyed listening to this record, and I recommend it to those who have a liking for Spanish-style music. The recording is of excellent quality. (H.A.T.)

This Snow White chick . . . was she one of the Seven Dwarfs group? ("TV Times").

HURT SO BAD — Nancy Wilson. EMI (Capitol) Stereo ST353.

Interest: Magnificent artist.
Performance: Very good.
Quality: Well recorded.
Stereo: Even spread.

When I reviewed Nancy Wilson's last album (Son of a Preacher Man — ST234) in these pages, I commented that she is "one of the most talented of the contemporary popular singers."

This new LP more than sustains her superb reputation. Like Sinatra, Bennett, Cole and a few others, she has the ability to make a song her own with her velvet-smooth voice, superb phrasing and intelligent feel for lyrics.

The material on this LP, however, is a shade disappointing with very few songs of outstanding merit. The tracks include, however, excellent performances of the recent chart success, "Spinning Wheel," Paul Webster's "Ages Ago," Alan Lerner's "Come Back To Me" and the beautiful Burke/Van Heusen song, "Do You Know Why."

As with most Nancy Wilson albums, the charts are immaculate and the quality of the musicianship very high. The arrangers include Phil Wright, Oliver Nelson, Jimmy Jones, Billy May and Sid Feller.

Despite the poor playing-time of 27 minutes (why is Capitol so disappointing in this regard?), this album will delight Nancy Wilson admirers, although they, too, would probably concede that she has made rather superior LPs in the past. (T.F.C.)

TODAY I SING THE BLUES — Aretha Franklin. C.B.S. Stereo SBP 233773.

Interest: Blues and Gospel.
Performance: Disappointing.
Quality: Poorly recorded.
Stereo: Normal separation.

For the past two years or so, both Festival and C.B.S. have been releasing Aretha Franklin albums in Australia. The Festival issues derive from her current Atlantic contract and, to this extent, the continuing release of the older Columbia recordings is misleading.

Judging from this latest C.B.S. album — which contains only 10 tracks and plays for a meagre 27 minutes — the Columbia well is fast running dry. In addition, these tracks are relatively poor-quality Aretha Franklin and will not enhance her reputation as one of the most exciting artists in the world today.

The most successful tracks on the album are Aretha's own "Without the One You Love," "Rough Lover," "Evil Gal Blues," "Every Little Bit Hurts" and the title track.

On paper, the backing looks strong with names like Jerome Richardson, Joe Newman, Frank Wess and Benny Powell but the arrangements and production are respectively dull and slack. Only the most devoted Aretha Franklin collector would find lasting value in this album. (T.F.C.)

* * *

FRANCOISE HARDY IN ENGLISH. Vogue Records (Festival) stereo SVL-933,391. Available in mono.

Interest: French singing star.
Performance: Pleasing style.
Quality: Excellent.
Stereo: Normal.

To the string of very successful Vogue discs released by Festival featuring the enchanting Francoise Hardy can now be added this latest one, which has the added advantage, for most people anyhow, that it is all sung in English. Most, if not all, of these numbers have already appeared in their French versions in the previous releases. If you have those, you will have to make your own decision as to whether you want both versions. You will probably be as charmed by M'selle Hardy's French accent as I was, but not surprisingly her singing loses something of the relaxed atmosphere which characterises her normal singing in her native language. The orchestral support and sound quality are entirely satisfactory.

To enable prospective purchasers to check against discs they already hold, I am giving both the English and French titles: This Little Heart (Ce petit Coeur) — All Over the World (Le Monde Entier) — However Much (Et Meme) — It's Getting Late (Il Se Fait Tard) — Only Friends (Ton Meilleur Ami) — Say It Now (Dis-lui Non) — Just Call And I'll Be There (Le Temp de Souvenirs) — The Rose (Mon Ami la Rose) — Only You Can Do It (Je Veux qu'il Revienne) — It's My Heart (Tu Peux Bien) — Another Place (La Nuit est Sur la Ville) — Autumn Rendezvous (Rendez-vous d'automne). (H.A.T.)

SONGS FOR SWINGING SELLERS. Peter Sellers and Irene Handl. Parlophone (E.M.I.) stereo SPMEO 9544 ($2.50).

Interest: British comedian.
Performance: Keenly satirical.
Quality: Good.
Stereo: Useful in places.

Sellers fans will be aware that he is no vocalist, and will be relieved to find that in this disc we are mercifully spared a demonstration of his singing ability for most of the time. The tracks are actually a series of satirical sketches, the main target of which is pretentiousness in all its forms. For example, the ancient singing fondly of "My Dear Old Dutch" (this being the only vocal effort by Sellers) heaps abuse on the poor old dear who is the object of his affection when she interrupts his song. The English upper class nobleman discusses his tenants as though they are so much livestock, in another track. One gem concerns the television interviewer who mercilessly assails the character of the interviewee, without letting him get a word in for his own defence. Even the sleeve note pokes fun at the solemnly worded nonsense commonly found in "Instructions for Use" notations.

Sellers is aided and abetted in his attacks by English comedienne Irene Handl, and as this is the only other credit given in the sleeve note (except in one instance) we must assume that the rest of the many voices heard are supplied by Sellers himself. He is certainly versatile enough to do this.

You will find plenty to raise a laugh in this disc, if your sense of humour is attuned to this kind of wit. Presumably the tracks have their origin in radio and television programs, but this information is not volunteered in the sleeve note. The sound quality is adequate. (H.A.T.)

* * *

THE BEST OF PETULA CLARK. Astor Stereo SPLP 1292 (mono compatible).

Interest: Popular English singer.
Performance: Strong selection.
Quality: Well recorded.
Stereo: Adds little.

Petula Clark's recent recordings have not repeated her huge successes of a year or two ago. But she is still one of the most consistent and talented singers in the business.

This "Best of" album has been sensibly compiled with hit singles like "Colour My World," "Don't Sleep in the Subway," "I Want To Sing With Your Band," "The Other Man's Grass" and "This is My Song."

"Extraordinary Value"

THE GREAT FRANK SINATRA. Music For Pleasure MFP-A8100-1. Mono.

Interest: 26 recordings, 1953-1961.
Performance: Generally excellent.
Quality: Acceptable.

This 2-LP set, released by Music For Pleasure at the bargain price of $3.95, contains some of Sinatra's finest recordings for the Capitol label. The tracks span the six years or so between December 1953 and March 1961.

During these years Sinatra was in magnificent voice, full of confidence and feeling and able to do full justice to a slow sentimental ballad and to a rip-roaring up-tempo song.

Some of the highlights on these two LPs include "I'll Be Around" (1955), "Moonlight In Vermont" (1957), "That Old Feeling" (1960), "Here's That Rainy Day" (1959), "That Old Black Magic" (1961), "Just One Of Those Things" (1954), "The Lady is a Tramp" (1956) and "I Concentrate on You" (1960).

As long established Sinatra collectors will recognise, these tracks come from a number of Sinatra Capitol LPs and duplication could well be a problem for many readers. But for someone with relatively few Sinatra albums, this 2-LP set represents quite extraordinary value. There is not a poor track among them and most of them rate with Sinatra's greatest work.

Unfortunately there are no recording details on the sleeve and, in addition, Nelson Riddle is credited with all the arrangement. In fact, Billy May was responsible for quite a few of the charts. Nevertheless, with the proviso mentioned above, this is one of the bargains of recent years. (T.F.C.)

THE GREAT NAT KING COLE. Music For Pleasure MFP-A8102/3. Mono.

Interest: Early Nat King Cole.
Performance: Generally first-class.
Quality: Acceptable.

Like the Frank Sinatra 2-LP set on Music For Pleasure, this represents quite extraordinary value. The first two sides were recorded by the Nat King Cole Trio in the years 1943 to 1949. During these years his Trio included outstanding musicians like Oscar Moore, Johnny Miller, Irving Ashby and Jack Costanzo.

But a large part of the charm of these Trio recordings comes from Cole's excellent piano. Jazz enthusiasts, of course, regret very much his abandonment of piano playing since the early fifties, for his instrumental work was delicate, swinging and very much in the Hines/Tatum/Wilson tradition.

The Trio tracks feature Cole's singing and playing on "Sweet Lorraine," "For All We Know," "Embraceable You," "Little Girl," "Making Whoopee" and seven more.

The 12 tracks on the second LP in this set include some of Nat Cole's big successes of the early fifties after he had forsaken the intimacy of the Trio for the more commercial lushness of Nelson Riddle's Orchestra. Most of the songs are first-rate including "Somewhere Along The Way," "Faith Can Move Mountains," "Because You're Mine," "A Weaver of Dreams" and "If I Give My Heart To You."

Duplication may again be a problem for many readers, but this 2-LP set would serve as an excellent introduction to Nat King Cole's early recordings of the late forties and early fifties. (T.F.C.)

say AKAI
and you're really talking tape recorders
say AKAI at ENCEL
and you really know your business

You know there's only one place to go if you're serious about tape recorders. To the place that has Australia's largest range . . . where the staff are all experienced audio-hobbyists . . . where you get meaningful demonstrations and knowledgeable answers to all your questions . . . where you buy at Australia's lowest prices and your purchase is backed by clued-up people with their own magnificently-equipped service centre, staffed by electronic experts. Yes, there's no better place to say "AKAI" than ENCEL!

Put yourself at the controls of this 3–motor AKAI X–200D

With features like this, its performance is outstanding:—

4-track stereo/monaural recording and playback. For playback the X-200D requires an external power amplifier and speakers. 3 speeds (1⅞, 3¾ and 7½ ips). 3 heads (erase, recording/playback and bias heads . . . CROSS-FIELD HEAD SYSTEM). 3 motors (hysteresis synchronous 3-speed motor for capstan drive, 2 6-pole eddy current out-rotor motors for supply and take-up reel drive). Wide CROSS-FIELD frequency response. Solid state pre-amplifier with 2 integrated circuits. Sensing tape continuous reverse (auto. reverse). Manual reverse shield type head for high S/N ratio. Two lever system ensures dependable and durable operation. Track selector for simple selection between stereo and monaural. Slide-type record level controls. 100 kHz biased for FM multiplex recording. Automatic stop/shut-off. Instant stop control with start button. Automatic pinch wheel release. Tape speed equalizer. Tape lifter in fast forward and rewind operation. DIN jack with selector switch for HIGH/LOW input. Stereo headphone jack. 4-digit index counter with reset button. Twin type VU meter with record indicator lamp. Fine oil-finished wooden cabinet. Universal voltage selector (from 100V to 240V; 50/60 Hz).

Say "AKAI" at Encel now and see what exciting things happen

ENCEL ELECTRONICS (STEREO) PTY. LTD.

Head Office: 431 Bridge Road, Richmond, Victoria 3121. Phone 42 3762

It is no coincidence that seven of the twelve tracks were written by Jackie Trent and Tony Hatch, for Miss Clark's most successful recordings were with compositions by this very talented husband-and-wife team. Most of the arrangements too, were written by Tony Hatch.

The 35 minutes of music on this album represent good value for admirers of Petula Clark. (T.F.C.)

★ ★ ★

THE BEST OF BILL COSBY. Stereo, Warner Bros., WS-1798.

Interest: More Cosby humour.
Performance: Usual Cosby style.
Quality: Good.
Stereo: Not important.

Like old Father Thames, Bill Cosby keeps rolling along, wowing them in the clubs, turning out more albums and producing new scripts — if, in fact, he can ever be thought of as working from a script.

This new album is entitled "The Best Of Bill Cosby" and, as might be expected, at least some of the tracks are repeated from other albums. Three tracks involving the story of Noah don't follow "The Book" at all closely. The same remark applies to "The Apple," with Adam and Eve as the main characters. Other tracks include: Revenge — The Lone Ranger — Old Weird Harold — Driving in San Francisco — Babies — The Water Bottle — Street Football — Fat Albert.

If you're a Cosby fan, this album will rate with the rest. If you want a Cosby record for that odd spot in your record sessions, I personally would suggest one of his earlier records which were a little more spontaneous, more truly reminiscent of Cosby junior. (W.N.W.)

Popular Jazz

KNOCKED-OUT NOCTURNE. Ralph Sutton. Festival (Project 3.) Stereo SPJL 933523.

Interest: Piano trio.
Performance: Excellent.
Quality: Superbly recorded.
Stereo: Good balance.

This LP by the rather neglected pianist Ralph Sutton is a most welcome addition to the local jazz catalogues.

Sutton first came to prominence during the war when he played with Jack Teagarden and his growing reputation was consolidated during his long resiency at Eddie Condon's Club in the late 1940s and early 1950s.

Sutton is one of the most accomplished of the post-war stride pianists with a masterful technique and creative ideas. The influence of Fats Waller, Art Tatum, James P. Johnson, Jess Stacey and Joe Sullivan is very obvious throughout the 12 tracks on this LP.

On most of them Sutton plays trio piano with the excellent backing of Bob Haggart (bass) and Gus Johnson (drums). On four tracks — "Honeysuckle Rose" "Hobson Street Blues" "Eye Opener" and "I Got Rhythm" — the trumpet of Yank Lawson and the soprano of Bob Wilber add some background colour to the sound and the latter contributes an elegant solo on the ballad "Love Lies."

The pick of the trio tracks include Beiderbecke's "In A Mist" and "In The Dark" and Waller's "Alligator Crawl" and "Viper's Drag."

The 37½ minutes of piano on this album will be a joy for all admirers of Ralph Sutton's tasteful swinging and inventive piano playing. Recommended. (T.F.C.)

★ ★ ★

COUNT DOWN — Charlie Munro. EMI (Columbia) Stereo SCXO 7911.

Interest: Australian modern jazz.
Performance: Adventurous.
Quality: Well recorded.
Stereo: Normal separation.

This album by Sydney musician Charlie Munro — the first local modern jazz LP for several months — was produced by EMI in association with the Australian Performing Rights Music Foundation.

The 51½ minutes of music is, at its best, adventurous, uncompromising and stimulating. Side one, "Count Down," was conceived as the music for a contemporary ballet, with five major soloists featured against a predominantly string orchestra. The soloists are Munro on reeds and flutes, Graeme Lyall on tenor, Bob McIvor on trombone, Mark Bowden on percussion and vibes and Bruce Cale on bass.

The ensemble passages seemed to me to be a little on the soft side and the score to lack structure and genuine direction. But the solos are the essence of the performance and, in this regard, the results are outstanding with all five musicians — particularly Lyall and Cale — improvising in a thoughtful and meaningful way.

The second side of the album contains two fully improvised pieces — "Whirlpool" and "The Scene" — with only the trio of Charlie Munro, Mark Bowden and bassist Neville Whitehead. Once again the solos are often imaginative and constructive but my overall impression was that the music was rather artificially free and deliberately contemporary.

I would not wish to give the impression that this LP is a failure, for it is very far from that — particularly on the grounds of the splendid solos. But somehow the music is not completely satisfactory; it lacks an authority and conviction which would have made it a great album.

By the same token, I am very sure that repeated playings over a period of months will prove to be rewarding. This Australian LP should at least be heard by all readers who profess an interest in contemporary jazz. (T.F.C.)

★ ★ ★

FLAMING YOUTH — Duke Ellington. RCA Vintage Series LPV 568.

Interest: 1927-29.
Performance: Magnificent tracks.
Quality: Very well remastered.

This is the third Duke Ellington LP which RCA issued to coincide with the

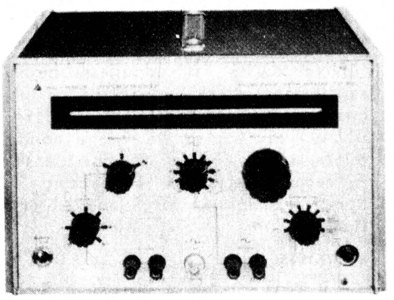
Here are the famous names in INSTRUMENTATION

together with the standard of service to match

A SELECTION FROM THE OUTSTANDING RANGE OF INSTRUMENTS AVAILABLE FROM JACOBY MITCHELL:

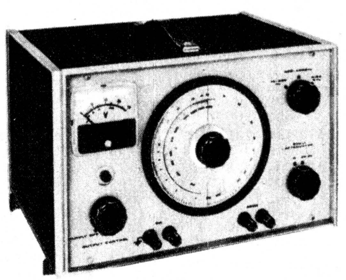
ADVANCE
Signal Generators

(1) VLF



SG72. New solid state function generator that gives sine, square or triangular simultaneous outputs from 0.01Hz to 1MHz. 1. Sine, square or triangular. Up to 30V pk-pk into 600Ω. 2. Fast, square wave, level IV pk-pk rise and fall times less than 5nS. 3. Square wave up to 10 pk-pk continuously variable, rise and fall times less than 7nS. Freq. accuracy ± 3%. [1]

(2) LF



J2E (above). AF Signal Generator covers the freq. range 15Hz to 50kHz in three ranges. Provides max. output of 1W with exceptionally low distortion level. Output impedance is maintained at approx. 600Ω over the entire range and a 20dB attenuator can be switched in to provide a higher order of impedance accuracy when required. An alternative 5Ω output is also provided. Overall distortion at full output power above 100Hz is less than 2%. Output level is monitored on a high-grade meter.

HIE. Provides a sinusoidal signal variable from 200 uV to 20V RMS over the freq. range 15Hz to 50kHz. Alternatively, a square wave output variable from 1.4mV to 140V pk-pk may be selected. [2]

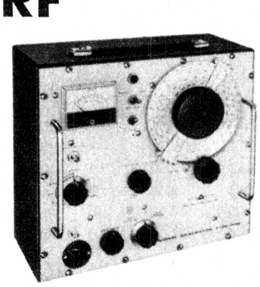
SG65A. An instrument of moderate price, primarily intended for educational purposes. Simple to operate, with wide freq. range of 10Hz to 100kHz. Two outputs: one a high impedance source with optional sine or square wave, cont. variable up to 6V RMS on sine wave and up to 9V peak on square wave. Also, a switched attenuator provides a 0-20-40 dB attenuated output. The other output is a low impedance source, available simultaneously and providing a sine wave with a max. power of one watt into 4 ohms within the range 50Hz to 20kHz. [3]

SG67A. A portable wide range oscillator providing sine or square wave output over freq. range 1Hz to 1MHz. [4]

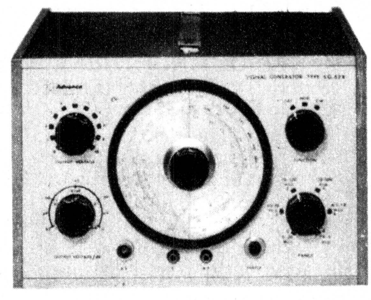
SG68. Provides an exceptionally low distortion sine wave output. Distortion is no greater than 0.01% over the range 20Hz to 20kHz. A square wave output with rise and fall times of less than 100nS is provided, and a max. output of 4V is available on both sine and square waves. A four-range push-button attenuator and calibrated fine adjustment controls output level. [5]

SG70. A high power LF unit with a sine wave output of 4W into 600Ω, 49V RMS or 4W into 5Ω over the freq. range 5Hz to 125kHz. Voltage level is adjusted by a seven-position attenuator (+ 30dB to − 20dB) and a cont. variable fine control. [6]

(3) RF



B4A7, B4B7 (above). Primarily intended as a lab. instrument and is available with alternative freq. ranges covering either 100kHz to 80MHz (B4A7) or 30kHz to 30MHz (B4B7). Cont. adjustment of RF output level is provided between 1uV and 100mV by a non-inductively wound potentiometer and step attenuator. The level can be accurately set by use of a crystal voltmeter which monitors the level into the step attenuator. Output signal can be modulated internally by 400Hz to a depth between 0 and 80% or by an external modulating source. [7]



SG62B. Produces RF signals over the wide freq. range 150kHz to 220MHz. A band spreading device ensures an open scale at the high frequency end of each band. The output signal may be either a continuous sine wave or may be modulated 30% at 400Hz. A truly portable instrument complete with case and carrying handle. [8]

E2. Operates entirely on fundamental freq. in the range 100kHz to 100MHz. It is characterised by exceptionally low RF leakage which, even at 100MHz, is less than 3uV. Attenuator system embodies a non-inductive slide-wire followed by a five-decade ladder network. The directly calibrated illuminated scale has a total length of over 30 in. Setting accuracy is assured by the inclusion of a 10:1 ratio slow motion drive. [9]

MAIL THIS COUPON TODAY

Jacoby, Mitchell & Co. Pty. Ltd.
Please send me details of the following instruments (place circle round applicable square)

[1] [2] [3] [4] [5] [6] [7] [8] [9]

NAME ....

ADDRESS ....

.... **POSTCODE** ....

EA570

Distributed by— **jacoby, mitchell & co. pty. ltd.**

469-475 Kent Street, Sydney. 26-2651

MELBOURNE	ADELAIDE	BRISBANE	PERTH	LAUNCESTON
30-2491/2	53-6117	2-6467	28 8102	2-5322

recent Australian Tour by the Orchestra — the other two being "Far East Suite" and "His Mother Called Him Bill."

Let me make it clear at once that this important reissue is essential listening for every collector with the slightest interest in Duke Ellington's music.

The sixteen tracks were recorded between October, 1927, and January, 1929, a period when the unique personality and character of the Ellington Orchestra were beginning to develop and emerge. At the same time the band was still dominated by its great individual soloists — particularly Bubber Miley and Joe Nanton — and in the context of the Cotton Club the band's sound was the "jungle" style.

This is a fascinating period in Ellington's musical development with the increase in the size — and textural potential — of the band the advent of new soloists like Hodges, Carney and Bigard and the increasing maturity and expertise of Ellington as a composer and arranger.

Ten of the sixteen tracks were composed by Ellington and four by Jimmy McHugh and Dorothy Fields but the latter are comparatively lightweight cabaret features. The outstanding tracks include classics like "Black and Tan Fantasie," "Jubilee Stomp," "Flaming Youth," "The Mooche," "Creole Love Call," "East St. Louis" and "Black Beauty" — all superb examples of vintage Ellington. Adelaide Hall sings on "Creole" and "Blues I Love To Sing," and, aside from Miley and Nanton, major soloists are Otto Hardwicke and Harry Carney (both musicians on alto and baritone), Artie Whetsol and Rudy Jackson.

Three tracks incidentally — "Blues I Love To Sing," "Washington Wobble" and Victoria Spivey's "No Papa No" — are previously unissued performances. The LP plays for a full 50 minutes: and the price is only $3.95.

This album is highly recommended to all collectors. (T.F.C.)

★ ★ ★

GREATEST HITS — Thelonius Monk. CBS Stereo SBP 233693.

Interest: 1960s material.
Performance: Useful collection.
Quality: Mainly good.
Stereo: Well balanced.

The suggestion in the album title that Thelonius Monk has recorded "hits" seems a somewhat extravagant term of phrase. The LP, in fact, includes nine of Monk's better-known compositions, which he has recorded for Columbia during the past seven or eight years.

Unfortunately, Monk's Columbia recording sessions have, with exceptions, been rather on the dull side and a compilation of his "best" work would have to include a majority of tracks which he recorded earlier for the Prestige and Riverside labels. Nevertheless, this album is probably a useful enough introduction to the jagged, stark but rewarding world of Monk.

Most of the tracks are by the quartet with Charlie Rouse on tenor, either Larry Gales or Butch Warren on bass, and Ben Riley or Frankie Dunlop on drums. The quartet recordings include Well, You Needn't — Misterioso — Bemsha Swing — Straight, No Chaser. Happily, the superb piano solos "Round Midnight" and "Ruby My Dear" are included and, in many ways, they are the most satisfying tracks on the album, with Monk at peak inspiration.

The late Pee Wee Russell joins the quarter on "Blue Monk" but this Newport Festival experiment was somewhat disastrous. The LP is completed by "Epistrophy," featuring Monk's ten-piece recording band but this track is too short for anything of substance to develop.

Mainly with newcomers to Monk's music in mind, this album can be recommended, particularly in view of the generous playing-time of 46 minutes. (T.F.C.)

★ ★ ★

FAR EAST SUITE — Duke Ellington and his Orchestra. Victor stereo LSP 3782.

Interest: Ellington 1966.
Performance: Outstanding.
Quality: Excellent recording.
Stereo: Good separation.

This is one of the three Ellington LPs which were released in Australia to coincide with his recent tour here. Nevertheless RCA should be roundly condemned for not releasing this superb LP earlier. It was, after all, recorded in December, 1966 and, cynically, one can well believe that it would never have been released in Australia had it not been for the tour.

Had it not been for "And His Mother Called Him Bill," this would undoubtedly have been the Ellington LP of the decade. The nine impressionistic sketches were composed between late 1963 and 1966 following Ellington's 1963 State Department Tour of the East and his 1964 visit to Japan. Clearly Ellington was influenced by the things he saw and heard on these tours but the music still remains pure Ellington/Strayhorn.

The Ellington band in 1966 was considerably superior to the one we saw here, principally because of the presence of Jimmy Hamilton, Paul Gonsalves, Lawrence Brown and Buster Kooper. These, and the other great soloists in the band, are well featured on the Eastern tone poems which comprise this LP.

The outstanding tracks are "Blue Pepper," "Isfahan" (both featuring Johnny Hodges), "Agra" (with Harry Carney), "Amad" (Lawrence Brown) and "Ad Lib on Nippon" which demonstrates the virtuosity of John Lamb on bass and Jimmy Hamilton on clarinet.

But once again, this Ellington album should be absorbed in toto, for the breathtaking textures in the orchestrations, the haunting, probing themes and the outstanding solo work by Ellington himself and his sidemen.

As in the case of "Bill," this album comes with the highest recommendation — not in terms of an LP that is simply good today, but in terms of a musical achievement that will stand the test of decades. (T.F.C.)

TRADE REVIEWS AND RELEASES

LUX SQ77T amplifier is good value

In the August 1969 issue of "Electronics Australia" we reviewed the LUX SQ1220 amplifier and found it to be very well finished and good value for money. Here we review the LUX SQ77T, a somewhat less expensive model, and find that it is also a good buy. It was submitted for review by International Dynamics (Agencies) Pty. Ltd., sole Australian agents for LUX equipment.

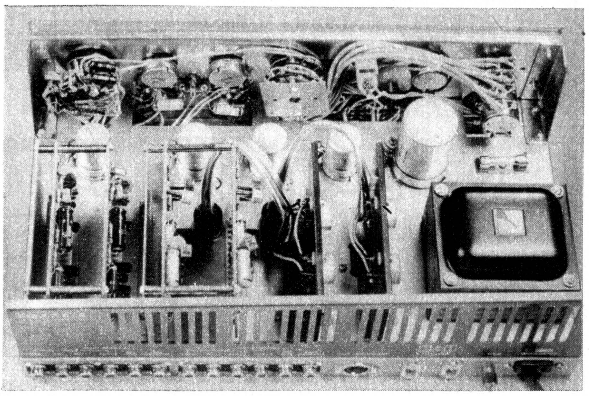
The overall dimensions of the amplifier are 14¾in x 5¾ x 8in deep. A wooden case is fitted and is included in the basic price. The front panel is of gold-anodised aluminium with a fine brushed finish. The turned aluminium knobs are finished and have a milled "flat" to give purchase and serve as a setting indicator. All the knobs rotate with a silky smoothness and the rocker switches have a positive snap-action.

Knobs are provided for the selector and mode switches, along with volume and balance controls and the separate bass and treble controls for each channel. Rocker switches are provided for power, tape monitor, scratch filter, rumble filter and loudspeaker/phone selector.

Phono sockets are provided on the rear panel for inputs for magnetic cartridge, tape, tape monitor, and two other auxiliary signal sources such as radio and TV. A 5-pin DIN socket is also provided for connection to a tape recorder. Loudspeaker outlets take the form of polarised sockets which take female plugs. These greatly reduce the possibility of short circuits and simplify the task of loudspeaker phasing. An unswitched 2-pin AC outlet is provided for connection of turntable or other low power appliance.

Removing the wooden cabinet of the amplifier reveals neat workmanship, easily serviced layout and good quality components throughout. The rear panel is ventilated to allow cooling of the vertically mounted heatsinks, which are quite small. The designers have evidently taken full advantage of the higher operating temperatures possible with silicon transistors. The majority of the circuitry is accommodated on four plug-in printed boards which are mounted toward one end of the chassis while the transformer is mounted at the other end.

At right is a view of the amplifier with the wooden case removed. The layout is clean and uncluttered.



One feature of the assembly we did not like was the mounting of the two fuseholders. These are mounted on the chassis so the amplifier must be removed from its case to replace fuses. The method of mounting is such that the fuseholder solder lugs are in very close proximity to the metal chassis — this is especially hazardous in the case of the mains fuse. Attention to this detail would be a worthwhile improvement.

The complete circuit of the amplifier contains 20 transistors in all, most of the circuit being fairly conventional. The input stage consists of two transistors connected in a direct-coupled feed-back arrangement and these provide equalisation and a degree of amplification for signals from magnetic cartridge, tape head (at one speed) and high level signals.

Following the input stage is the tone control stage consisting of two transistors in a conventional negative feedback configuration. At the input to this stage are the "scratch" and "rumble" filter components which give a modest rolloff at 5KHz and 80Hz, respectively. The scratch filter is not sharp enough to be effective against bad noise and similarly, the rumble filter is not sharp enough to enable turntables with a lot of inherent rumble to be used satisfactorily.

The volume control for each channel consists of a pair of ganged potentiometers, one operating at the input of the tone control stage and the other at the output of the same stage. This ganged pair is ganged with the potentiometers for the other channel. This arrangement has apparently been adopted, as in the Lux SQ1220 referred to above, to maintain an optimum signal-to-noise ratio over the whole control range. It would also have the effect of providing the tone control stage with excellent overload capability.

The power amplifier stage is very similar to that used in the Lux SQ1220 amplifier and consists of six transistors in a direct-coupled feedback amplifier with the output transistors connected in a conventional quasi-complementary configuration.

The rated power output of the amplifier is 60 watts RMS (30 watts per channel) into 8-ohm loads and 40 watts RMS (20 watts per channel) into 16-ohm loads. Total harmonic distortion was rated at less than 0.5 per cent at 20 watts into 16 ohms at 1KHz.

We measured power output at 23 watts per channel into an 8-ohm load at the onset of clipping and 28 watts with one channel driven. THD at 1KHz at 23 watts per channel was 0.4 per cent and 0.3 per cent at 28 watts with one channel driven.

Power output into 16-ohm loads was 15 watts per channel and 17 watts with one channel driven. Distortion at 1KHz was 0.3 per cent at 15 watts per channel and 0.2 per cent at 17 watts into one channel. The figures for power output are a little down on those claimed but this would not be apparent in a domestic situation.

Frequency response at 1 watt and power bandwidth at 23 watts per channel were the same with minus 3dB points at 28Hz and 50KHz, which is excellent. Separation between channels referred to 28 watts into 8-ohms was very good at minus 48dB over the range from 100Hz and 10KHz. This was measured with the non-driven channel input unloaded. All the above measurements were taken using the Auxiliary input which had an input sensitivity of 200mV RMS.

The tone controls gave a range of plus 8dB and minus 9dB at 10KHz and plus 11dB and minus 10dB at 100Hz, which is less than usual but adequate for most purposes. Square wave response was good over the whole range and stability with capacitive loads was excellent.

Sensitivity of the various inputs was found to be very close to the figures specified but the overload capability could be improved upon. The magnetic cartridge input could handle 30mV RMS at 1KHz before audible overload occurred. While this represents a factor of some 24dB it is

really not sufficient, as some medium output cartridges will deliver in excess of 30mV on peaks. The input sensitivity of 1.8mV RMS for full power could easily be reduced to improve the overload capability, while still maintaining adequate sensitivity. For best results with this amplifier, use a low output cartridge.

On actual listening tests the amplifier performed well. There was no switch-on transient in the loudspeakers when first turning the amplifier on and at all settings of the controls the amplifier was commendably quiet. Using a low output magnetic cartridge there was gain to spare and no lack of power.

To sum up, this amplifier offers good power capability at a reasonable price. With some small detail improvements it could be made even more attractive.

Retail price of the amplifier is $169, including tax, and it is available from outlets in most states. Trade inquiries regarding availability of this and other products in the Lux range should be made to the Australian distributors, International Dynamics (Agencies) Pty. Ltd., 4 Duke Street, Abbotsford, Victoria. (L.D.S.)

INSTRUMENTS FROM AWA

Marconi Instruments Ltd., of the U.K., has announced a number of additions to its range of equipments distributed in this country through the Engineering Products Division of A.W.A.

Counter/Timer, TF 2411. Performs a wide range of functions including period and multi-period measurements, time interval, ratio and frequency measurements to 50MHz. Features: a choice of plug-in frequency standards; uses mainly ICs; FET input with 10mV sensitivity and 1M input impedance; seven digit readout with binary memory; optional BCD printer output; HF-cut filter to exclude electrical interference.

Counter/Timer, TF 2414A. Solid-state 6-digit single channel instrument. Features: 10mV sensitivity; direct frequency measurement down to 40MHz; time interval measurement down to 1uS: period and multi-period measurement; 1M input impedance; display memory; stability and accuracy determined by oven-controlled crystal oscillator; standard frequency output available over range 0.1Hz to 1MHz.

Sweep Generator, TF2361. The basic unit, which is converted to video or VHF version by plug-in units, contains common power supplies and driving circuitry. Features: sweep speeds from .01Hz to 100Hz; frequency range 25KHz to 300MHz; automatic level control; frequency markers; each plug-in unit has calibrated sweep-width control; linear centre-frequency scale; can be locked to TV sync and blanking waveform.

Wide-Range Oscillator, TF 2103. Transistorised sinewave/squarewave portable oscillator continuously variable from 10Hz to 1MHz. Features: five range-selecting push-buttons; effective scale length exceeds 3ft; output signal amplitude continuously variable (in four switched ranges) from 0 to 2.5V; normally operates from two internal 9V batteries, but interchangeable mains power unit is available.

Power Supply, TF 2150. Bench-type miniature unit with continuous control of both current and voltage. Features: maximum output 25W; range 0-30V, 0-1.25A; regulation better than .05pc; ripple less than 400uV; accuracy at 30V, 2pc; non re-entrant current protection; no range switching; can be operated as pulsed power source, linear DC power amplifier, etc. by changing terminal connections.

Further information on these and other instruments in the Marconi Instruments range is available from Amalgamated Wireless (A'sia) Ltd., P.O. Box 96, North Ryde, N.S.W. 2113.

NEW RH (Radio House) RANGE OF MULTIMETERS

Model RH-80 $18.00 Postage 50c

20,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:

DC Volts. 0.5, 2.5, 10, 50, 250, 500, 1000 V

AC Volts. 10, 50, 250, 500, 1000 V

DC Current: 50uA, 5mA, 50 mA, 500 mA

Resistance. 5 kΩ, 50kΩ, 500kΩ, 5 MegΩ

Decibels. —10 + 62 lb

Accuracy. DC±3%, AC ±4% (of full scale)

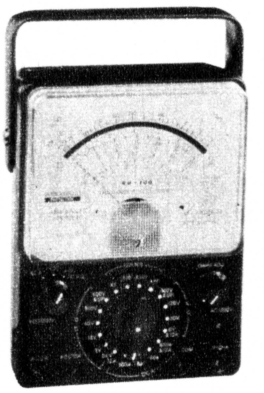
Batteries. Two 1.5V dry cells. Size AA, "Eveready" 915

● Overload-protected by dual silicon diodes. ● Mirror scale. ● Double-jewelled ±2% meter. ● ± 1% temperature-stabilized film resistors.

Model RH-100 $39.75 Postage 75c

100,000 Ohms per Volt DC 10,000 Ohms per Volt AC

● Overload Protected by Dual Silicondiodes ● Double-jewelled ± 2 per cent Meter ● ±1 per cent Temperature-stabilised Film Resistors ● Polarity Changeover Switch ● Mirror scale, instruction for operation with circuit diagram.



SPECIFICATIONS:

DC Volts: **0.6, 3, 12, 60, 300, 600, 1200V (100,000Ω/V)**

AC Volts: **6, 30, 120, 300, 1200V (10,000 Ω/V)**

DC Current: **12μA, 300 μA, 6mA, 60mA, 600mA, 12 amps DC and AC Current 12 amps.**

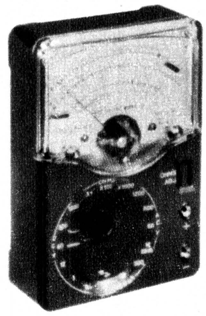
Resistance: **20KΩ, 200KΩ, 2MΩ, 20MΩ**

Decibels: —20 to + 17, 31, 43, 51, 63.

Accuracy: DC±3 per cent, AC± 4 per cent (of full scale)

Batteries: Two 1.5V dry cells, size AA, "Eveready" 915

Model RH-20 $15.00 Postage 50c



20,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:

DC Volts: 0.25, 2.5, 10, 50, 250, 1000 (20,000/V)

AC Volts: 10, 50, 250, 500, 1000 (10,000/V)

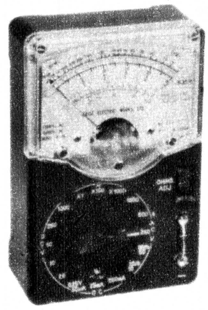
DC Current. 50 uA, 25mA, 250mA

Resistance. 7kΩ, 700kΩ, 7MΩ

Decibels. —10 +22 (at AC/10V) +20 +36 (at AC/50V). Upper frequency limit 7kc.

Batteries: Two 1.5V dry cells. Size AA, "Eveready" 915

Model RH-55 $20.00 Postage 50c



30,000 Ohms per Volt DC
14,000 Ohms per Volt AC

SPECIFICATIONS:

*DC Volts: 0.6, 3V, 12V, 60V, 300V, 1200V (30,000 ohms/V.

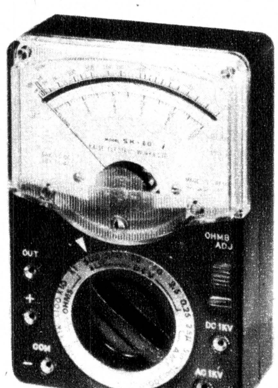
*AC Volts: 12V, 60V, 300V, 1200V (14,000 ohms/V).

*DC Current: 60 A, 12mA, 300mA.

*Resistance: 10K ohm, 1Meg ohm, 10Meg ohm.

*Decibels: -10 db +23 db.

Model RH-60 $25.00 Postage 50c



50,000 Ohms per Volt DC
10,000 Ohms per Volt AC

Specifications:

DC Volts: 0.25, 2.5, 10, 50, 250, 500, 1000 V

AC Volts. 10, 50, 250, 500, 1000 V

DC Current. 25 uA, 5 mA, 50 mA, 500 mA

Resistance: 10 kΩ, 100 kΩ, 1 MegΩ, 10 MegΩ

Decibels. —10 +62 db

Accuracy: DC±3%, AC± 4% (of full scale)

Batteries. Two 1.5 V dry cells. Size AA, "Eveready" 915

Models RH-20, -55, -60 are:—

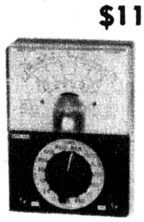
● Overload-protected by dual silicon diodes ● Mirror scale ● Double-jewelled ±2% meter ● ±1% temperature-stabilised film resistors.

NEW TYPE Y-3 MULTIMETER

MEASURING RANGE: D.C. Voltage: 6V, 30V, 150V, 600V (2000 ohms/V). A.C. Voltage: 6V, 30V, 150V, 600V (2000 ohms/V). D.C. Current: 150 mA. Resistance: 0-100,000 ohms. Complete with 1.5 volt battery and test leads. Size: 3¾" x 2¾" x 1⅜".

Checked, Packed and Posted — $9.50. Limited Stocks.

"HANDYMAN" RH 150 $11.50



CHECKED PACKED & POSTED FREE

Pocket-size 3¼" x 4½" x 1¼". Instruction sheet and circuit.

SPECIFICATIONS

DC Volts 2½, 10, 50, 250, 1000.
AC Volts 10, 50, 250, 500, 1000.
DC Current, .1, 25, 250 M/amps.
Resistance, 20K and 2 megohms.
Decibels, —20db = +62db .7K/c.
Capacitance, .0001, .01, .0025, .25 mfd.

NOTICE

The Royal Arcade Branch shop has been closed during rebuilding. Enquiries 26-3846.

NEW FOR 1970 —

digital electric alarm clock, **$19.75.**

Crystal radios, **$3.95,**

Six transistor pocket radios, **$11.75,** and seven transistor micro-radios, **$39.75.**

TAPE RECORDER

$20.50

BOOK TYPE

The latest model portable Tape-recorder. 4 transistor, 3in reels, 2 tracks. Instruction manual. Size 10¼in x 7in x 1¼in.
Just open the book and record. Supplied complete with tape, microphone and batteries. Special discount price, **$20.50, posted anywhere.**

RADIO HOUSE PTY. LTD.

306-308 PITT STREET 61-3832 26-2817 760 GEORGE STREET SYDNEY. 211-0171

AKAI X-330 STEREO TAPE RECORDER

The Akai X-330 tape recorder is a machine offering a high degree of versatility. It has comprehensive reverse playing facilities and is equipped with its own power amplifiers for playback. It was submitted for review by the distributors, Akai Australia Pty. Ltd.

The X-330 is a 3-motor, 3-speed, 4-track stereo machine which is equipped with power amplifiers. It has comprehensive reversing facilities, using either metallic sensing tape or its own inbuilt timer. It can be used with reels up to 10½ inches in diameter and has the usual facilities incorporated in a multihead machine, i.e., sound-on-sound and echo. The unit is housed in an oiled teak case with matching lid.

At first sight, the number of controls on the deck is rather awe-inspiring and one almost wonders whether this effect was deliberately intended. In actual fact, the deck operation is quite straightforward. The tape transport itself is very complex, in spite of the use of three motors, which usually tend to simplify the mechanism. Five push-buttons on the right side of the deck control the tape transport via solenoids, while additional switches on the left side of the deck select forward or reverse operation and tape speed. Above the tape head cover is the four-position tape tension selector and above that the tape reversing counter and selector control.

On the lower left side of the deck are a pair of concentric level controls for the microphone and line inputs. Also in this control grouping is the speed equalisation selector. A rocker switch below this alters the equalisation (and also the bias level, we would presume) to suit standard or low-noise tape. Equalisation is to the NARTB curves. On the right lower side of the deck are bass and treble controls and concentric volume controls for tape or disc playback.

Two VU meters are provided for signal level monitoring but they are not calibrated. This would seem to be an unfortunate omission as it makes it difficult to reference levels to anything but what the manufacturers have adopted as "normal."

Also provided on the front panel are two jack sockets for microphones and a jack socket for low impedance stereo headphones. A recessed panel in the side of the case accommodates loudspeaker outlets, line inputs and outputs, and inputs for a magnetic cartridge.

In operation, the machine is a pleasure to drive. The tape transport is very smooth, quiet and spill-free due to the solenoid controls. The fast forward and reverse facility takes 75 seconds to rewind a 1,200 feet reel of tape. It is possible to go from fast forward to fast reverse without an intermediate stop without any problems of tape spillage or other malfunction. The tape transport is foolproof to the point that even disconnection of the mains supply will not cause tape spillage. The transport merely brakes to a smooth stop.

Very low figures are quoted for wow and flutter, as follows: Less than .04pc at 7½ips; less than .07pc at 3¾ips and less than 0.15pc at 1-7/8ips. While we did not attempt to verify these figures, wow and flutter were noticeably absent at all speeds.

The unit can be set to turn itself off (with any ancillary equipment connected to the rear mains output socket) at the end of a reel of tape. Virtually the only mechanical feature which could be added to the deck is that of a pause control, to minimise the "click" or "bong" which is recorded on the tape when restarting.

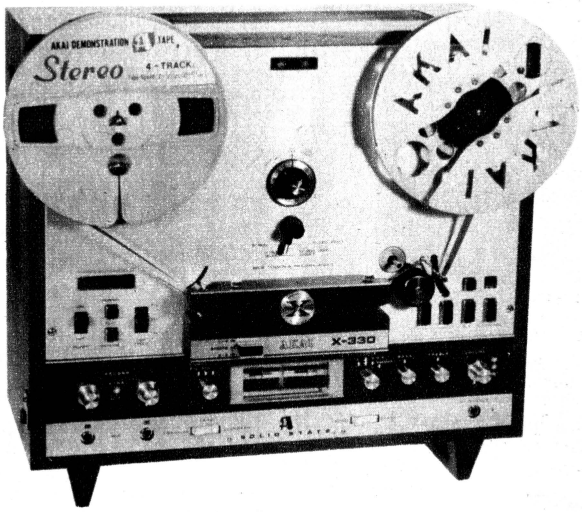
A remote control traverse unit is available as an optional accessory.

The machine can be used as the heart of a stereo system using discs or tape. A magnetic cartridge can be played straight through the machine without the transport being used, i.e., the machine is used as a conventional audio amplifier. Accordingly, we measured the performance of the audio amplifier section as a first step.

The replay amplifiers in the unit are rated at 15 watts per channel or 20 watts music power. We measured 9.4 watts RMS per channel into 16-ohm loads just before the onset of clipping. Total harmonic distortion at 1KHz at this power was 1.2 per cent. With 8-ohm loads we measured 12.5 watts per channel at 1KHz for a total harmonic distortion of 2.5 per cent. Total harmonic distortion at a level of 1 watt into 8 ohms was 1.2 per cent. We did not measure power output into 4-ohm loads and we presume the amplifier was not intended for use with 4-ohm speakers. Indeed, there was no instruction in the owner's manual regarding the impedance of the external loudspeakers nor was there any indication on the circuit diagram.

We measured the frequency response of the amplifiers via line input at a level of 1 watt. To obtain the optimum frequency response we had to set the bass control to its extreme anti-clockwise position and the treble control at 12 o'clock. This gave a curve which was —3dB with respect to 1KHz at 26KHz and +7dB at 30Hz.

The treble control gave a range of plus or minus 5dB boost or cut at 10KHz and



Pictured is the X-330 recorder which has a very versatile tape transport mechanism. The machine can take reels up to 10½in in diameter and has excellent frequency response characteristics.

NEW ALL TRANSISTOR STEREO AMPLIFIERS
ULTIMATE IN DESIGN—LONG DEPENDABILITY
USING ALL SILICON TRANSISTORS
36 WATTS—RMS

SPECIFICATIONS:
POWER OUTPUT: 18 watts per channel R.M.S. Total output 36 watts R.M.S.
FREQUENCY RESPONSE: From 20 cycles to 20,000 ± 1db.
HARMONIC DISTORTION: Less than 1 per cent at 14 watts output.
HUM AND NOISE: Aux. 70db, Mag. 50db.
INPUT SENSITIVITY. Mag. 3mv. Aux. and tuner 200 mv.
SPEAKER IMPEDANCE: 8 oms.
EQUALISED: Mag. RIAA.
TONE CONTROLS: Bass 50 c/s ± 12db. Treble 10 kc/s ± 12db.
LOUDNESS CONTROL: 50 c/s 10db.
SCRATCH FILTER: (High filter) at 10 kc/s 9db.
RUMBLE FILTER: (Low filter) at 50 c/s 5db.
PROVISION FOR TAPE RECORDER. Record or play-back with din plug connnection.
PROVISION FOR HEADPHONES with headphone/speaker switch on front panel.

MODEL C300/20

$119.00 FREIGHT EXTRA.

DIMENSIONS: 16½in v 5¼in x 11in deep.

Mounted in oiled walnut or teak veneered cabinet, with metal trim and matching knobs.

THE CIRCUIT INCORPORATES regular power supply with transistor switching protection for output transistors. 26 silicon transistors plus 5 diodes are used.

MODEL C300/20/T

ABOVE AMPLIFIER WITH INBUILT A.M. TUNER

$144.00 FREIGHT EXTRA

12 WATT RMS PER CHANNEL VERSION OF AB OVE AMPLIFIERS AS PREVIOUSLY ADVERTISED ALSO AVAILABLE. $134.00 WITH TUNER.

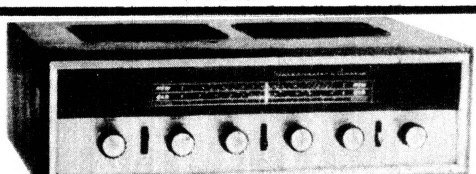
NEW 24 WATT R.M.S. TRANSISTOR AMPLIFIER WITH INBUILT A.M. TUNER

MODEL C250

$118.00 FREIGHT EXTRA

DIMENSIONS 15¾in x 4¼in x 11in deep.
Cover finished in teak or walnut wood grain.
Incorporates 24 low noise silicon transistors plus 5 diodes.

SPECIFICATIONS:
POWER OUTPUT. 12 watts per channel 24 watts R.M.S. total (48 watts music power).
FREQUENCY RESPONSE. 20 Cycles to 20,000 ± 1db.
HARMONIC DISTORTION. Less than 1% at 10 watts.
HUM AND NOISE. Aux. 70db. Mag. 50db.
INPUT SENSITIVITY. Mag. 3mv. Aux. 200mv.
SPEAKER IMPEDANCE. 8 ohms.
EQUALIZED. Mag. RIAA.
TONE CONTROLS. Bass 50c/s ± 12db. treble 10kc. ± 12db.
LOUDNESS CONTROL. 50c/s 10db.
SCRATCH FILTER. (High filter) at 10kc. 9db.
PROVISION FOR TAPE RECORDER. Record or play back with standard din plug connection.
TUNER. This unit can be supplied with either valve or transistor tuner with a coverage of 530 to 1,600 K.C. Calibrated dial



$118.00 FREIGHT EXTRA.

MODEL C200V. BASED ON THE PLAYMASTER 118 WITH TUNER

Dimension 16½in x 5¼in x 11in.

CABINET IN OILED WALNUT OR TEAK WITH METAL TRIM.

This amplifier is based on the Playmaster 118 circuit as featured in "Electronics Australia," to which has been added the following features:

- Inbuilt high gain A.M. tuner with a coverage of 530 to 1,600 K.C.
- Loudness control giving bass boost at low volume.
- Provision for tape, record and play-back, with din connector.
- Calibrated dial available for all States.
- EM84 tuning indicator giving accurate tuning with ease.

POWER OUTPUT: 9 watts per channel R.M.S. FREQUENCY RESPONSE: 20 to 20,000 cycles incorporating Ferguson O.P.412 gain oriented output transformers. VALVES USED: 4-6GW8, 12AX7 or 12AU7, 6AN7, 6N8, EM84 and 2 silicon diodes.

CLASSIC RADIO

245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE 798-7145

the bass control gave a maximum of 8dB of boost at 50Hz in addition to that already inherent in the amplifier's response.

Akai tape recorders are unusual in that they use a separate head to apply the bias signal to the tape instead of applying it via the recording head. It is claimed that this technique results in less attenuation of the high frequency audio signals. Indeed, the frequency response specification for the machine is quite ambitious. At 7½ips it is specified as flat from 30Hz to 25KHz within ±3dB; from 30Hz to 18KHz within ±3dB at 3¾ips and from 30Hz to 9KHz within ±3dB at 1-7/8ips.

An improved specification applies if "low-noise" tape is used, as follows: 30Hz to 26KHz within ±3dB at 7½ips; 30Hz to 20KHz within ±3dB at 3¾ips and 30Hz to 13KHz within ±3dB at 1-7/8ips. It is good to see a different specification quoted for low-noise tape. Some manufacturers quote an ambitious performance without stating that low-noise tape must be used to realise the specification. For all our tests we used a high-quality standard virgin tape.

The record/replay characteristic was taken at a signal level 20dB below 0 VU using the line inputs and outputs. This means that the irregular frequency response of the power amplifiers does not enter into the measurement. Since the VU meters were not calibrated we took 0 VU to be the upper extreme of the "black" region of the meter scale.

At 7½ inches per second we found the record/replay characteristic to be flat within ±1dB from 30Hz to 20KHz; at 3¾ips it was flat within ±2dB from 30Hz to 18KHz; at 1-7/8ips it was flat within ±2dB from 30Hz to 9KHz. Thus, the frequency response specification is comfortably met and this aspect of performance must be regarded as excellent. Total harmonic distortion at 0 VU was 2.5 per cent while the signal-to-noise ratio with respect to 0 VU was 40dB. These figures are not as good as those specified but are quite satisfactory. Separation between channels was measured at —40dB with respect to 0 VU at 1KHz.

To sum up, we found the machine performed very well, both in its mechanical functions and in electrical performance. Some aspects could be improved upon, however. The first of these is that the machine can too easily fall forward when used in the vertical mode. The feet-cum-handles are largely to blame for this plus the fact that the three motors and power transformer are all mounted at the top of the case, giving it a high centre of gravity. The manufacturer could improve the stability by the use of wider handles.

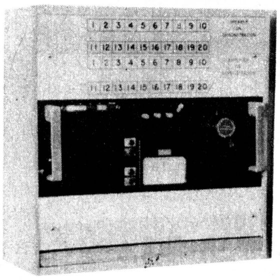
The vinyl-covered push-buttons on the deck are an ostentatious touch and may look "tatty" after a period of use, when the adhesive has aged. We would have preferred aluminium or even plastic.

While it is possible to make a direct comparison between the signal from the line or microphone sources and that recorded on the tape, it is not possible to make this same comparison between the magnetic cartridge signal and that recorded on tape.

Finally, we feel that the power amplifiers could be substantially improved for a machine in this price range, particularly with respect to harmonic distortion. Each amplifier comprises of four transistors and uses a driver transformer. The circuit design is, frankly, out of date, although we do admit that it is possible to obtain excellent performance from amplifiers using driver transformers. Akai, themselves, manufacture amplifiers which far surpass the performance of those in the X-330.

Unfortunately, first cost plus import duty puts this machine out of the range of all but the most "well heeled" tape enthusiast. The retail price is $734. The machine is available from tape recorder retailers throughout Australia. Trade enquiries should be directed to the Australian distributors for Akai equipment, Akai Australia Pty. Ltd., 276 Castlereagh Street, Sydney, or interstate offices. (L.D.S.)

VEALLS' AUDITORIUM & COMPARATOR

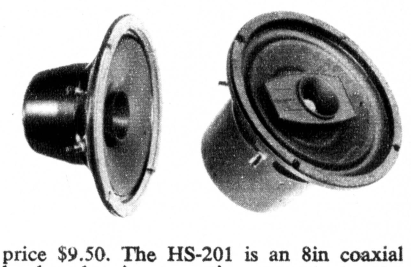


A versatile audio comparator (right) installed in Vealls' auditorium (above). The comparator, built by the company's technical department, enables any pair of 10 sets of loudspeakers to be demonstrated with any one of 10 amplifiers and any one of six record players. The comparator is not available commercially, but further details may be obtained from Vealls Electrical & TV Pty. Ltd., 512 Bridge Road, Richmond, Victoria. 3121.

TRADE RELEASES -- in brief

FAIRCHILD AUSTRALIA PTY. LTD., 420 Mount Dandenong Road, Vic. 3136. Agents for Data General Corporation, U.S.A. **Supernova small computer.** The second in a family of small computers marketed by Fairchild (the first being the Nova computer). Features: full memory cycle using core 800nS; read-only memory cycle time 300nS; four full 16-bit word accumulators; core memory of 4,096 16-bit words; core memory expandable in 2K and 4K blocks to 32,000 words and physically interchangeable with read-only memory; teletype interface; input/output facilities include high speed data channel and automatic interrupt source identification. A new standard option on both the Nova and Supernova is multiply/divide hardware which is added directly to the central processor hardware. The Australian price for Supernova is $13,175 including control console, 4K memory and teletype.

H. ROWE AND CO. PTY. LTD., 7 Flinders Court, Melbourne, 3000. Australian agents for Peak. **Hi-fi loudspeakers, models 8A7a and HS-201.** The 8A7a is an 8in twin cone loudspeaker with a music power rating of 8W, nominal frequency response of 60Hz to 15KHz, and available in either 8 or 16 ohms impedance. Retail



price $9.50. The HS-201 is an 8in coaxial loudspeaker incorporating separate tweeter and mid/base loudspeaker. Nominal frequency range is 50Hz to 20KHz, music power rating is 20W, and impedance is 8 ohms. Retail price $30.50.

GRANGER ASSOCIATES PTY. LTD., 1 Dale Street, Brookvale, N.S.W. 2100. Agents for Hatfield Instruments, U.K. **Psophometer, model 1000.** A low cost, active-network instrument which features telephone and/or broadcast weighting characteristics, as required by the C.C.I.T.T., obtained by front panel switching without external networks. Other features include: meter calibrated in dBm and voltage; external recorder may be used, without loss of accuracy, in addition to monitor headphone; level response from 50Hz to 20KHz in "flat" position; 2KHz plug-in active filter may be fitted for crosstalk measurements in telephone transmission systems; can make "weighted" noise measurements in the presence of voltages up to 300V DC; rugged but lightweight carrying case; in addition to conventional 600 ohm terminated and high impedance (through) connections, includes 600 ohm with centre tap to earth and high impedance with series capacitor.

MINNESOTA MINING AND MANUFACTURING (AUST.) PTY. LTD., 950 Pacific Highway, Pymble, N.S.W. 2073. **Professional audio recorder/reproducer model 401.** Two convertible models are available: a 2in 16-track console with NAB electronics, for which a head stack assembly is available to convert it to a 1in 8-track recorder/reproducer; a 1in 8-track recorder/reproducer which may be converted to a 2in 16-track with NAB electronics. Features of the 2in 16-track model include: adjustable tape guides for either 1in or 2in tapes; smaller than an average 4-track recorder/reproducer; adjustable

azimuth heads; compact remote overdub control. The company will also offer at a later date a 2in 16-track reproducer-only, model 402.

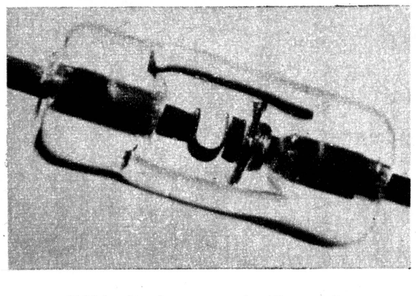
CRAMMOND RADIO MANUFACTURING CO. PTY. LTD., 463 Vulture Street, East Brisbane, Qld. 4169. **Marine transceivers, CTR70 and CTR72 series.** Type approved by the P.M.G.'s Dept., meet marine transceiver specification RB208, and have satisfactorily completed tests to comply with the requirements of schedules 2 and 3 of the Commonwealth Navigation (Radio) Regulations. These tests are very stringent and include vibration, bump, dry heat, damp heat, low temperature, and corrosion (salt water) tests.

SWE-CHECK INSTRUMENTS, 93 Cavanagh Street, Cheltenham, Vic. 3192. **FET-VOM meter.** Uses FET circuitry protected by zener diode. Weighs 1½lb, and measures 6¼in high x 4¾in deep. Ranges: DC volts 0 to 1, 2, 3, 10, 30, 100, 300V and 1KV; AC volts 0 to 3, 10, 30, 100, 300V and 1KV; Ohms Rx1, Rx100, Rx10K, Rx1M (10 ohms, 1K, 100K and 10M centre scale respectively). Calibration accuracy on DC and Ohms is within 3pc and on AC volts within 5pc. Price, through leading wholesalers, is $56 plus sales tax

AMALGAMATED WIRELESS (A'ASIA) LTD., 348 Victoria Road, Rydalmere, N.S.W. 2116. **Low power FM IF amplifier-demodulator, type AWM1306.** A monolithic linear IC with principal applications in narrow-band FM receivers where low power-dissipation is important. It consists of a high gain 1MHz amplifier-limiter and a quadrature FM discriminator. Supply voltages are internally regulated, and the input impedance is set for matching typical ceramic IF filters. Complementary outputs from the discriminator provide for simple DC alignment and external bypassing is non-critical.

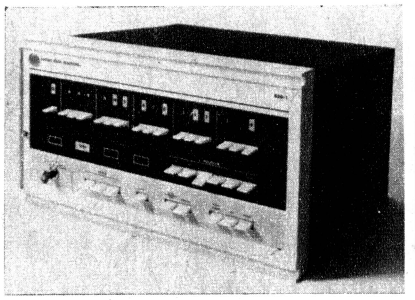
General characteristics: Package, 12-pin hermetic TO-5; maximum storage temperature, 150 degrees C; operating temperature range, 0 to 70 degrees C; supply voltage, 4.5 to 12V; power dissipation, 12mW (typical); RF gain, 90dB (typical); RF bandwidth 1MHz at 3dB (typical); input impedance, 1.2K (typical); recovered audio, 200mW (maximum).

HEWLETT-PACKARD AUSTRALIA PTY. LTD., 22-26 Weir Street, Glen Iris, Vic. 3147. **PIN diode, type 5082-3080.** Suitable for use as a current-controlled resistor in AGC circuits of mobile communications equipment, in TR switches and other applications where RF power needs to be controlled electronically. Features: frequency range 1MHz to 1GHz; distortion not greater than .05pc; cross-modulation products typically less than 0.5pc with respect to signal levels; second order distortion products below .05pc; RF resistance, controlled by DC forward bias, can be varied linearly between 5 and and 2500 ohms; break-down voltages greater than 100V; DC power dissipation up to 250mW at ambient temperature of 25 degrees C; workable temperature range from minus 65 to plus 150 degrees C. Small quantity price is $2.95, prices for larger quantities are available from the company.



PIN diode type 5082-3080.

Varian mini-computer



Representative of the very latest "state of the art" digital mini-computers is this unit, the Varian 620/f. It features a basic cycle time of only 750nS, which Varian claims to make it the fastest small computer currently available. Although fully compatible with all software written for earlier models in the Varian 620 series, the new machine offers not only a 2:1 speed increase but also a number of new instructions, optional 300nS read-only memory, direct memory access, and facilities for up to 32 input/output or storage peripherals. (Varian Data Machines — Varian Pty. Ltd., 38 Oxley Street, Crows Nest, N.S.W. 2065.)

Philips new 50 MHz oscilloscope with unbeatable input sensitivity/bandwidth combination

The PM3250 is a general-purpose oscilloscope designed for applications where high bandwidth and/or high sensitivity are required.

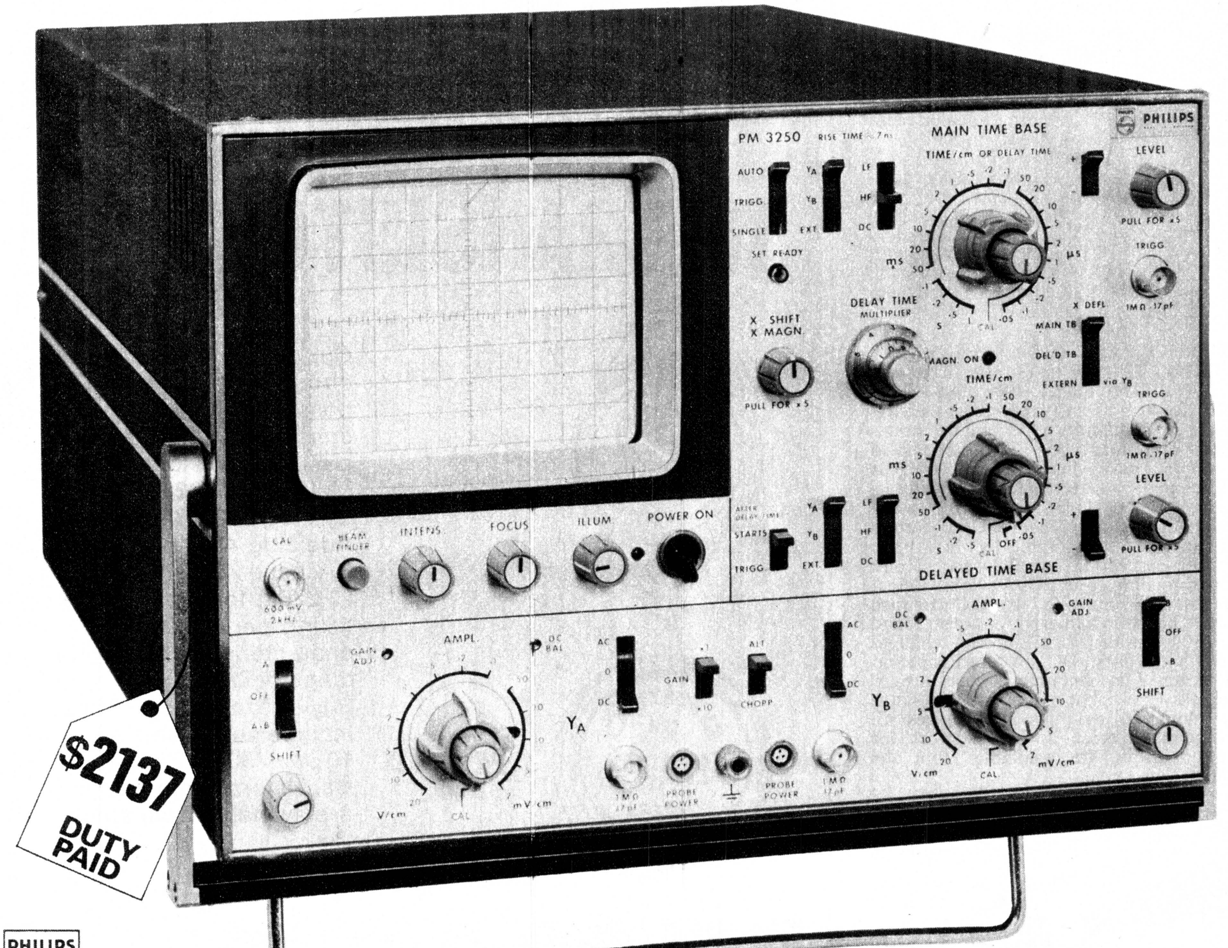
Its versatility and accuracy have been extended to give complete reliability to measurements with sensitivity as high as 200 μV due to the feedback of drift.

A differential measurement of 2 signals A — B can be displayed *together* with one of the original signals. A delay line in the vertical channel allows investigation of leading edges with a minimum of signal distortion.

- Simple sweep delay controls
- 5 MHz X-Y measurements at high sensitivities

2mV X-axis: 200 μV Y-axis

For full specifications, contact Philips Electrical Pty. Limited, 69-79 Clarence Street, Sydney, 2000, or your nearest branch.



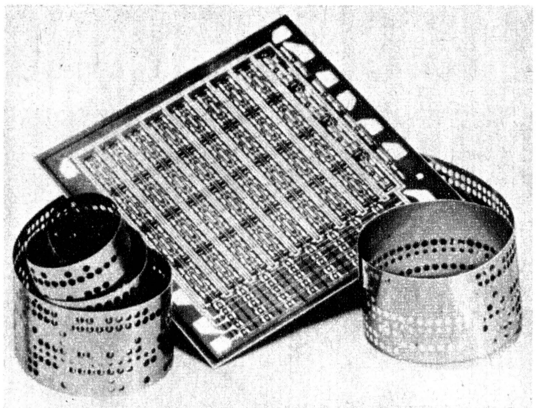
PHILIPS

test and measuring instruments

PHILIPS

38-8919

MOS Random Access Memory



A master photograph of the Motorola MC117OL random access memory.

MOTOROLA SEMICONDUCTOR PRODUCTS, 37-43 Alexander Street, Crows Nest, N.S.W. 2065. **MOS random access memory, type MC117OL.** A high performance, low cost 64-bit random access memory for use in 500nS or less access time systems. Organised as 16 words of 4 bits each and fabricated from P-channel enhancement mode devices, the MC117OL uses four-input binary addressing with full decoding performed on the chip. An enable input is also provided for easy address expansion. Read/write buffer circuits on the output bit lines allow as many as 20 bit lines to be "wired ORed". System timing is not critical because of the single-phase clock used by the device.

Power dissipation of the MC117OL is about 325mW when operating from 30V and 15V sources. It is supplied in a 14-pin dual-in-line package for operation over the 0 to 75 degrees C temperature range. The price of the MC117OL is $13.70 in 100-up quantities.

RACAL ELECTRONICS PTY. LTD., 47 Talavera Road, North Ryde, N.S.W. 2113, has announced the following appointments. Mr Aub Roberts as production manager. Prior to joining Racal, Mr Roberts held senior positions with T.E.I., Hills Electronics and Centre Industries. Mr John McGivern as chief accountant. Mr McGivern was previously senior accountant with T.E.I. Mr Maurice Bowman, previously Racal purchasing officer, has been promoted to supply manager.

BRITISH MERCHANDISING PTY. LTD., 49-51 York Street, Sydney, 2000, has announced that Mr Julian W. Dinsdale, senior electronics sales engineer for the B.M.P. group of companies, has recently returned from an extended overseas visit. Mr Dinsdale visited Derritron Electronics, Vibrators Ltd. and Racal-Thermionic Ltd. for whom British Merchandising and Tape Recorders Pty. Ltd. are sole Australian agents. As a result of his visit the B.M.P. group is extending the consultancy and after-sales back-up service facilities for the vibration testing and data acquisition systems.

HAWKER SIDDELEY ELECTRONICS LTD., 752 Pittwater Road, Brookvale, N.S.W. 2100, has appointed Mr G. J. Donnan as commercial director of the company. Mr Donnan is responsible for corporate marketing and planning both in Australia and overseas. Mr Donnan is also a director of Ferris Bros. Pty. Ltd., Allied Capacitors Pty. Ltd., and other subsidiaries.

G. J. Donnan

J. Wiggins

MOTOROLA SEMICONDUCTOR PRODUCTS, a division of Motorola Australia Pty. Ltd., 37-43 Alexander Street, Crows Nest, N.S.W. 2065, has appointed Mr Jim Wiggins as sales engineer. Mr Wiggins was formerly with Cannon Electric (Australia) Pty. Ltd. in Sydney.

AUSTRALIAN GENERAL ELECTRIC PTY. LTD., 103 York Street, Sydney, 2000, has appointed Mr John McKim as general manager, Information Systems, with responsibility for the company's business computer operations, including equipment sales, field engineering services, time-sharing and batch processing. Previously, Mr McKim managed the equipment sales and field engineering aspects of Information Systems. He succeeds Mr Barry Eames, who has accepted the position in the U.S.A. of marketing manager, GE-265 Time-Sharing Plans and Programs, responsible for the development of 30 time-sharing centres throughout the U.S.A.

PLESSEY PACIFIC PTY. LTD. has appointed Mr Edward Fair as the company's purchasing executive. Mr Fair was previously general purchasing manager with Massey-Ferguson (Aust.) Ltd. He is a Fellow of the Australian Institute of Management and a Member of the Institute of Business Administration.

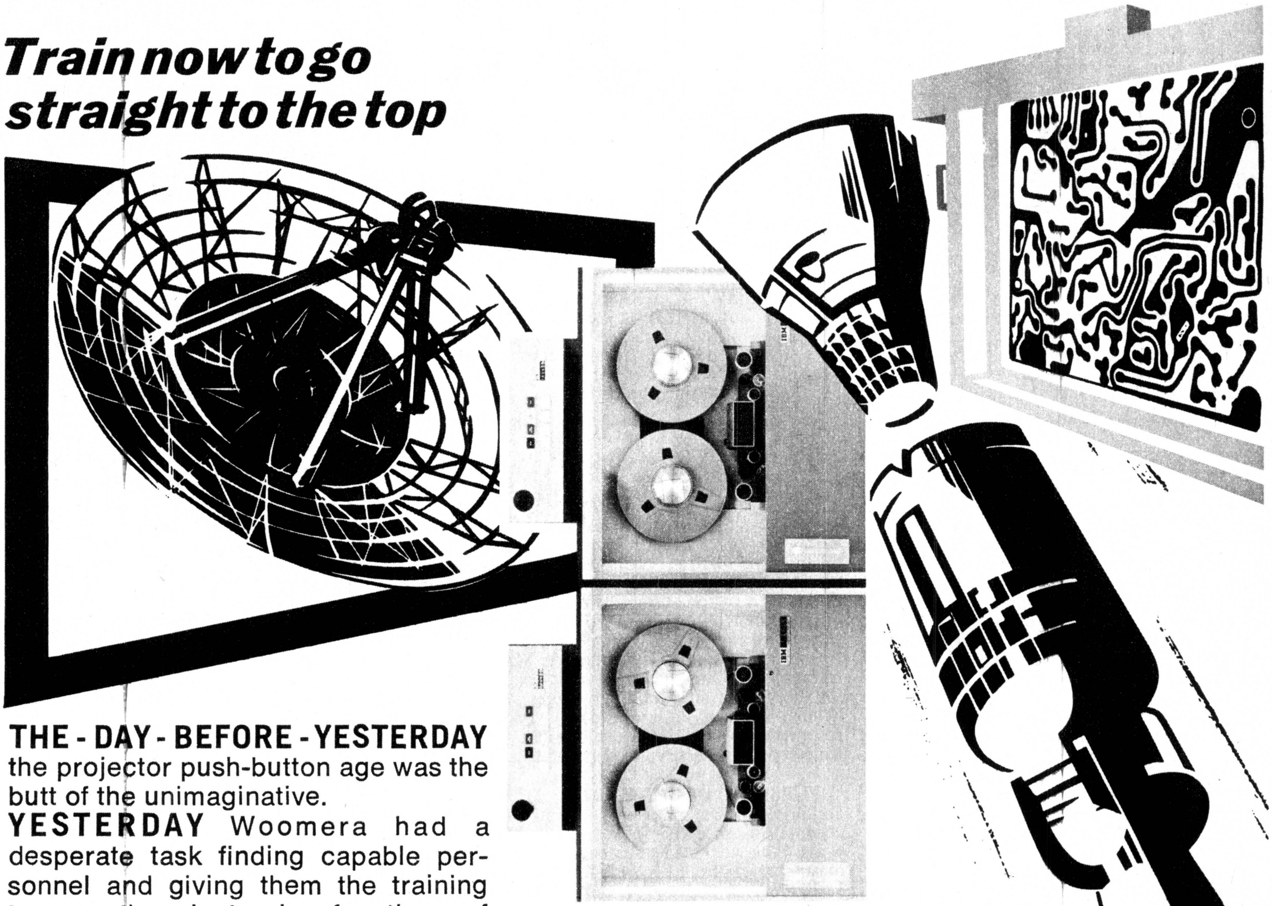
AKAI AUSTRALIA PTY. LTD. has announced the winners of the Akai sales promotion contest for 1969. The first prize, won by Douglas Trading Pty. Ltd., of Melbourne, consists of a 26-day tour of the Orient by Qantas, including 13 days in Japan and visits to Hong Kong, Bangkok, Taipei and Singapore. Mr B. J. Douglas and his family leave for the trip on May 9. The second prize, an 18-day tour of Japan and Hong Kong, was won by Encel Electronics (Sales) Pty. Ltd., Sydney. The Sydney manager, Don Oates will be taking this trip. Other major prize winners were Telair, Brisbane (10-day tour of Fiji), Mastertone Elect., Dee Why, N.S.W. (10-day tour of Fiji), and Sunstrom Elect., Adelaide (set of golf clubs).

H. M. COMPONENTS & CO., P.O. Box 14, Williamstown, Vic. 3016, has been appointed sole Australian agent for W. S. Suddentsche Gluhlampen Fabrik, the German manufacturer of miniature lamps. The W.S. range comprises a fully comprehensive selection of indicator lamps.

VEALLS ELECTRICAL & TV PTY. LTD., 512 Bridge Road, Richmond, Vic. 3121, has opened a specialised division for hi-fi stereo and audio equipment. A spacious, carpeted lounge with comfortable chairs and settee has been provided for customers. A special audio comparator enables any two pairs of loudspeakers to be demonstrated from any one of ten stereo amplifiers. Change over is effected in three seconds.

INDUSTRY IS CLAMOURING FOR
ELECTRONICS ENGINEERS

Train now to go straight to the top



THE - DAY - BEFORE - YESTERDAY the projector push-button age was the butt of the unimaginative.
YESTERDAY Woomera had a desperate task finding capable personnel and giving them the training to man the electronics functions of the space research complexes.
TODAY all Australian industry is committed to an immediate future of electronic concepts. These expose splendid new frontiers of production, of work output in commerce, of living standards. The lack of skilled personnel alone could retard this progression into a totally new world. Eventually the lack will and *must* be overcome. Meantime, Australia will search desperately about the world for the people with electronic skills. Already there is a dearth of them in Australia, *and overseas!* Trained Australians can choose their workplace from the whole world. If you train now with I.C.S., you will be rewarded well. You will reach the top of your profession while many thousands are just beginning to train.
Make your decision for success now!

These specialised subjects are available from I.C.S. for home study.

- ☐ Audio: Hi-Fi, Stereo
- ☐ Automation Electronics
- ☐ Automatic Controls
- ☐ Industrial Applications
- ☐ Nuclear Instrumentation
- ☐ Digital Techniques
- ☐ Transistors & Semi-Conductors
- ☐ Communications
- ☐ Monochrome and Colour TV
- ☐ Electronic Drafting
- ☐ Printed Circuits, Conventional
- ☐ Printed Circuits, Micro Integrated
- ☐ Fringe Equipment

Also Computer Programming for Commerce, Research, Industry.

Read the FREE I.C.S. Illustrated Prospectus

Send Coupon today!

International Correspondence Schools,
Dpt. 527, Division of Electronics,
400 Pacific Highway, Crows Nest, N.S.W. 2065.
Branches in all States and New Zealand.

ICS

Please send me FREE Prospectus about ....

Name .... Age ....
(Please print)
Address ....
.... State ....
Postcode .... Phone .... Dpt. 527

TECHNICAL BOOKS AND PUBLICATIONS

Rockets, missiles . . . and electronics

ROCKETS AND MISSILES by John W. R. Taylor. Hamlyn all-colour paperback published by Sun Books, Melbourne. Stiff paper cover, 160 pages, 7 x 4 inches. Price in Australia and New Zealand 99c.

This is not a book about electronics but it does cover devices which, teamed with electronics, have more than anything else dramatised the progress of modern science and technology. The author, W. R. Taylor, is well qualified to tell the story of rockets and space flight, being a product of the aircraft industry and Editor of "Jane's All The World's Aircraft."

The first chapter outlines the early history of rocketry and the reader is reminded that the story of the rocket as a weapon stretches back over something like 1000 years.

A second section, involving some fifty pages, takes up the story from Hitler's buzz-bombs and V2 rockets, tracing the development of missiles and their control systems to the relatively sophisticated weapons of the present day. Included in this section are anti-aircraft, anti-tank, anti-submarine and other such weapons, infantry and air-borne missiles and, of course, the larger ballistic missiles right through to the ICBMs.

Less foreboding is the section "Rockets Into Space" which again starts with the German V2 but which traces the efforts of scientists to probe the mysteries of space and then of space travel. All of this will be in the living memory of many readers but it is a story which easily stands re-telling.

This leads naturally into a section "Reaching For The Moon," a series of achievements which concentrates very largely in the past eleven or twelve years. The author recounts the historic flight by Armstrong and Aldrin, then takes a brief look into the near future at proposals for a manned orbital laboratory, aerodynamic spacecraft and other devices which are currently at the top of the list in space programs.

A book which is packed with interesting information and right up to the minute. Our copy came from the publishers. (W.N.W.).

1970 Handbook

THE RADIO AMATEUR'S HANDBOOK Published by the American Radio Relay League Inc., Newington, Conn., U.S.A. Amply illustrated with line drawing and photographs. Soft cover, 643 pages, 9½in x 6½in.

This, the 47th edition of what has become, perhaps, the most widely used reference text for radio amateurs remains basically unchanged from previous editions, although considerably updated in many sections.

Fundamentals, because they are fundamentals, remain essentially unchanged. For this reason the early chapters dealing with basic theory and components are virtually identical from year to year. There is, however, an increasing emphasis on solid-state devices and their application, both in the theory chapters and in the more specific material presented later in the book.

The application and construction data includes a lot of new material and is consistent with the current state-of-the-art in this rapidly developing field.

The chapter dealing with HF receivers includes designs suitable for relatively inexperienced constructors, together with more advanced designs suitable for amateur station use. Transmitter construction employs recent valve types, some of which are well beyond the pocket of most local amateurs but, perhaps fortunately, also well beyond the legal power limit applicable in Australia.

It is in the chapters dealing with VHF and UHF techniques that the increased emphasis on solid-state devices is most evident. None of the receiver designs employs valves of any type, preference being given to JFET and IGFET application. Several low-power solid-state transmitters are also described.

Aerial design and construction are covered in a manner which permits the amateur to satisfactorily develop a system or systems tailored to his own specific needs without slavishly following someone else's pattern. Just sufficient maths is introduced to enable the necessary design calculations to be made with a minimum of effort.

The section exhibiting the greatest change is that dealing with mobile techniques where a wide range of equipment, both HF and VHF, is described. This is in keeping with the apparent upsurge of interest and activity in this mode of amateur operation.

The valve data at the end of the book is adequate for most "ham" requirements although the semiconductor section is not perhaps as comprehensive as might be expected.

This is a handbook which can be confidently recommended to those desiring to break into the highly interesting field of amateur radio. The reproduction of the construction photos, together with the quality of printing are of the highest order.

Our review copy came direct from the publishers in the U.S.A. but this volume is available locally through technical booksellers in each State. The soft cover edition is listed at US$6.00 with a hard cover edition available at US$8.00. Australian prices will normally be somewhat higher. (A.D.N.)

About the weather

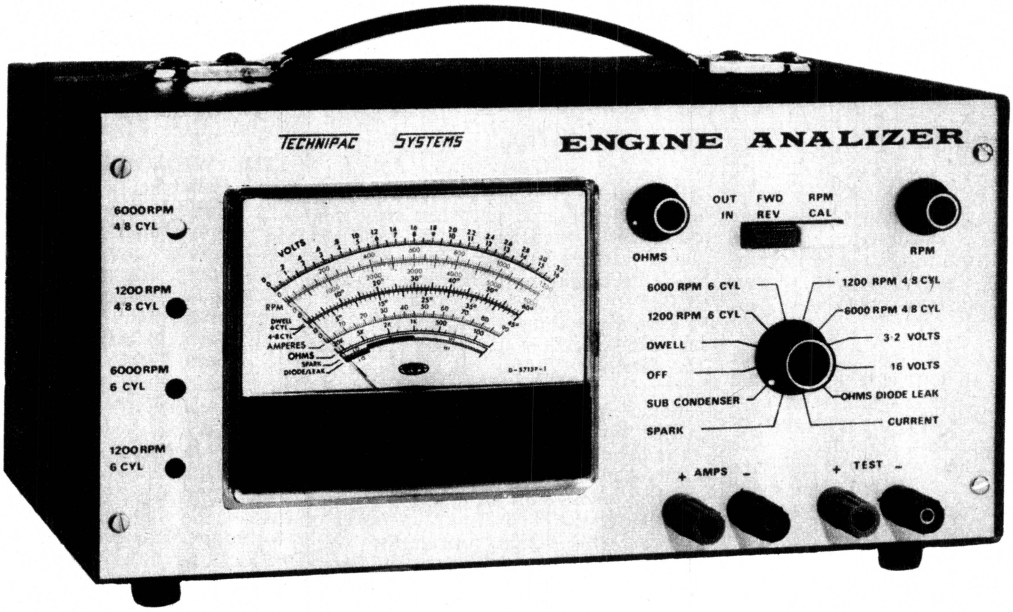
THE WEATHER GUIDE, by A. G. Forsdyke, B.Sc., Ph.D., A.R.C.S. Published by Paul Hamlyn, London, and Sun Books, Melbourne. Colour paperback series, glossy cover, 160 pages, 7in x 4in, freely illustrated in full colour, and with numerous diagrams and charts. Price in Australia and New Zealand, 99c.

"From biblical times to the present day weather forecasting has attracted considerable interest. Its exponents have included the charlatan and soothsayer . . .; shrewd observers of wind and sky like farmers and sailors; and the modern scientific meteorologist. This book has no more to say about the first group; it is concerned with weather study as a science, but it recognises the wisdom, expressed in weather lore, of those whose livelihood is earned out-of-doors."

That quotation from the foreword to this book sums up its aims quite nicely. (The final statement may be taken as an admission that the ancient rule of thumb predictions of the country dweller occasionally prove more accurate than the results of the complex meteorological networks now operating).

The book has all the usual hallmarks of the Hamlyn all-colour paperbacks. The author is highly qualified (40 years experience with the U.K. Meteorological Office); the text is concise and factual, but tending to be superficial; and there are the usual very attractive and informative full colour illustrations on virtually every page. Mr Forsdyke has bent over backwards to avoid blinding his readers with science, but unfortunately he appears to be too close to his subject to avoid leaving some doubts in the reader's

NOW AVAILABLE FOR THE FIRST TIME IN AUSTRALIA!



THE D.K.I. ENGINE ANALYSER

by TECHNIPAC

This versatile, accurate test instrument, designed to professional standards, is fully transistorised and is battery operated. Functions include:

1. Voltage Measurements
2. Current Measurements
3. Generator Testing
4. Alternator Tests
5. Solenoid Tests
6. Voltage Regulator Tests
7. Relay Tests
8. Starter Motor Tests
9. Distributor Tests
10. Points Tests
11. Condenser Leakage
12. Distributor Wear
13. Ignition Coil Test
14. Spark Gap Tests
15. Spark Lead Testing
16. Dwell Angle Measurements
17. Tachometer Reading
18. Carburettor Air Filter Tests
19. Idle Adjustment
20. Power Balance on all cylinders

This instrument is complete with full operating instruction manual detailing testing procedures and fault finding techniques on all makes of cars. It carries a written warranty against defective parts or equipment. Made in Australia

AVAILABLE ONLY FROM: TECHNICAL TRAINING INTERNATIONAL PTY. LTD.
75 Archer Street, CHATSWOOD, N.S.W. 2067
P.O. Box 328, CHATSWOOD 2067

PRICES

In kit form with full assembly instructions.
$65.00

Fully assembled ready for use.
$75.00

Both above prices include SALES TAX, DELIVERY AND INSURANCE while in transit to any address in Australia.

ORDER FORM

To: Technical Training International Pty. Ltd.
P.O. Box 328, CHATSWOOD 2067
Please forward me the D.K.1 Engine Analyser in:

☐ Kit form with Assembly instructions.
☐ Fully assembled ready for use.

I enclose Cheque/M.O. for $

Name

Street

City

State Postcode

EA

mind in a few places. Also, he is apparently not an experienced author, and has the disturbing habit of referring his readers to subject matter not yet covered in the text, some 20 or 30 pages ahead.

Apart from these defects, which are not really serious, the book may be regarded as successful. Despite Mr Forsdyke's localised experience, he does not restrict his account to U.K. conditions, but covers all parts of the world. He explains the factors which influence weather, such as temperature, atmospheric pressure, wind and radiation; weather conditions, with a particularly interesting section on clouds; weather maps and forecasting, with explanations of the peculiar lines and symbols on weather maps which are apt to confuse the layman; climate (past as well as present) in different parts of the world. The final chapter deals with the problem of air pollution, and the basis of the old weather lore. A list of suggested further reading is included.

No prior knowledge of the subject, or for that matter any special knowledge at all is required of the reader. In some places the desire to simplify appears to be taken to extremes (it hardly seems necessary to explain that heavy rain will sometimes transform drought areas into flood areas). However as first reading into a fascinating subject, the inexpensive and attractive little book has much to recommend it. (H.A.T.).

Photoelectronics

PHOTOELECTRONIC DEVICES. By J. B. Dance M.Sc., B.Sc. Published 1969 by Iliffe Books Ltd, 42 Russell Square, London, W.C.1. Hard covers, 172 pages 8½ x 5½ inches, illustrated by diagrams and circuits.

With the enormous amount of research that is currently going on into display and other electron-optical devices, this book by J. B. Dance is timely. With a Master's degree from Birmingham University, the author gained experience at the Harwell Atomic Research Establishment, held a number of lecturing posts and is now back at the Birmingham University, researching neutron detection and scintillation counters.

Chapter 1 of the new book, entitled "Introduction" provides a brief but effective survey of the integration of photons with matter, including mention of the relevant units.

Chapter 2, involving 17 pages, provides a brief but basic survey of semiconductor fundamentals, with appropriate emphasis on photoconductive and photoemissive effects.

This leads into a study of photoemissive materials and photocathodes of various types, which have provided the basis for generations of evacuated and gaseous phototubes. In fact, the next two chapters deal at some length with the nature and circuit applications of two-element phototubes (referred to as photoemissive diodes) and the much more complex photomultipliers.

In chaper 6, page 88, the author leaves behind glass envelope devices for "Homogenous Semiconductor Photodevices" including cadmium sulphide and cadmium selenide cells and suchlike.

Junction photodevices are covered in chapter 7, their principles and typical circuit applications. One notes mention of photodiodes, readout cells, solar cells, selenium barrier layer cells, phototransistors, light-actuated PNPN devices and integrated circuit photodetectors.

The remaining chapters deal with image intensifiers and converters and with electroluminescent devices.

Of particular note is the comprehensive bibliography which is provided at the end of each chapter. This and the index round out what should be a most useful addition to the literature on this important subject.

To gain maximum value from the book, the reader would need to be familiar with electronic terminology and have a background in physics. However much useful information could be derived by anyone interested in the subject having only an electronic background. Our copy came direct from the publishers but supplies should be available in due course through technical booksellers. (W.N.W.)

Solid State

DOPING AND SEMICONDUCTOR JUNCTION FORMATION by Marshall Sittig. Published by Noyes Data Corporation, Park Ridge, N.J., 1970. Soft covers, 8-3/8in x 10¾in, 318pp., many diagrams. Price in U.S.A. $35.

This volume is the latest release in Noyes Data Corporation's series "Electronics Materials Review," which are specifically intended to supply information on recent developments in technology for those in management, research, engineering development, marketing, and education.

Like the other books in this series, Doping and Semiconductor Junction Formation is basically an in-depth review of the specific content of recent U.S. patents in the field concerned. As such it is intended to provide a concise, accurate and up-to-date reference of the current state of the art, a reference whose content should be considerably in advance of that in currently published texts, journals and other reference literature.

The content material in the present volume is grouped under the following general headings: 1— Introduction; 2— Production of Alloyed Junctions; 3— Diffusion Processes; 4— Melt Grown Junctions; 5— Doping During Melting; 6 — Simultaneous Doping and Substrate Deposition; 7 — Spark Doping Processes; 8 — Doping by Particle Bombardment; 9— Hydrothermally Grown Junctions; 10— Doping Epitaxially Grown Layers; 11— Future Trends.

In each section the processes and techniques are discussed thoroughly and concisely, illustrated in most cases by coded patent-form diagrams. Full details are given of the individuals and companies associated with a process and its patent, the author stressing in his foreword that great care has been taken to ensure that this information is not only reliable and comprehensive, but also sufficiently detailed to avoid legal criticism for "insufficient disclosure."

The book is quite unpretentious in form, with unjustified text whose appearance suggests photocopying from an electrically typewritten manuscript. On superficial examination this may suggest that the book is somewhat overpriced. However, in view of the wealth of concise practical information which it provided on the "fine details" of current semiconductor technology, it should be found of very great value not only by those in industry and research, but also by lecturers and students involved in engineering courses at both graduate and undergraduate level.

The review copy came directly from the publisher, whose address is Noyes Building, Park Ridge, New Jersey 07656, U.S.A. (J.R.)

LITERATURE—in brief

MULLARD OUTLOOK, Vol. 13, No. 1, January-February, 1970. Published by Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney, N.S.W. 2000. Contents: Viewpoint with Mullard; Digital integrated circuit applications, part 2; Mullard pot core substitution; Junction field effect transistors; Mullard at the 1970 Physics Exhibition; New planar transistors for switching 150W pulses; New Gunn effect devices; Integrated circuit cross reference. Also included with this issue is the Table of Contents for Volume 12, 1969.

PLESSEY ELECTRONICS PTY. LTD., 91 Murphy Street, Richmond, Vic. 3121, has published product data sheets which give details of high stability, close tolerance, quartz crystal units designed and manufactured for the telephone, computer, electronic, aircraft, and radio communication industries. Units described include: the P-2 (Model HC6U), available in a frequency range 800KHz to 100MHz in a sealed, plated and wire mounted unit filled with an inert gas; the P-3 (Model HC18U), subminiature, plated wire mounted assembly with a frequency range of 5 to 100MHz, supplied in a hermetically sealed gas-filled holder.

AMALGAMATED WIRELESS VALVE CO. PTY. LTD., Private Mail Bag, Ermington, N.S.W. 2115, has available the following publications of RCA Electronic Components, U.S.A. RCA Solid-State Product Guide. Lists brief specifications for the RCA range of semiconductors including transistors, diodes, rectifiers, thyristors, integrated circuits, photoconductive devices and an infrared emitter. RCA MOS Field Effect Transistors Product Guide. Includes construction, features, quick selection guide, ratings and typical characteristics, typical transfer characteristics, typical circuits, application notes, and dimensions.

USING THE 675A/676A NETWORK ANALYZER AS AN EDUCATIONAL TOOL, Application Note 112-2, published by the Hewlett-Packard Co., U.S.A. Inquiries to Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Vic. 3147. A 17-page application note, useful for both the instructor and student, describes frequency behaviour of electrical networks. Demonstrations illustrate frequency swept transfer and driving point measurements displayed on a conventional oscilloscope. Included with each application note is a Nichols chart oscilloscope CRT overlay to predict the closed loop behaviour of feedback network designs.

WORLD TELECOMMUNICATION DAY, May 17, 1969. Booklet No. 5, published by the International Telecommunication Union, Place des Nations, 1211 Geneve 20, Switzerland. Paper covers, 5¾in x 8in, 106 pages with several photographs. Price, 2 Swiss francs. A special brochure giving an account of the information received by the I.T.U. and showing the efforts made by all those countries who took part in the first World Telecommunications Day.

Contents: Foreword; Message from U Thant, Secretary-General of the United Nations; Message from Mr M. Mili, Secretary-General of the International Telecommunication Union; Messages of congratulations received from United Nations Specialised Agencies and other sources; Celebration in Geneva of World Telecommunication Day; Celebrations throughout the world (reports of activities in 91 member countries.

Free publications from Radio Nederland

Radio Nederland has available a number of publications which have been compiled to help the DXer and shortwave listener to improve reception or to extend the scope of the receiver.

An aerial booklet deals with such subjects as selecting and siting, insulation, height, length, materials, matching, screening and lightning protection. It contains sketches of the antenna types described. A converter booklet gives instructions for building a shortwave converter covering the 13, 16 and 19-metre bands (15 to 22MHz). A separate section tells how to make it suitable for other ranges. The converter uses valves, and the booklet includes the circuit and a number of other diagrams.

Radio Nederland has published a number of data sheets on the following subjects: selectivity improvement; the Q-multiplier; image frequencies; a beat frequency oscillator; transistorised crystal calibrator; product detector; the BC-221 frequency meter; the frame aerial as a directional medium wave aerial. Two non-technical items available are: This is DXing; and an English-Spanish DX Vocabulary.

Radio Nederland's technical courses, previously broadcast in "DX Juke Box," have been re-issued in the form of postal tuition. The following are available: Shortwave Propagation Course; All Round DXers' Course; DX Receiver Course; DX Antenna Course. Enrolment is accepted for one course only at a time.

The various booklets, data sheets and courses are obtainable free of charge from DX Information Service, c/o Radio Nederland, P.O. Box 222, Hilversum, Holland. Inquirers should state clearly what is required, and print name and address in block capitals.

RECENT PUBLICATIONS OF THE S.A.A.

The Standards Association of Australia, 80 Arthur Street, North Sydney, N.S.W. 2060, has published the following:

Annual list of Australian Standards, 1970. Lists titles and gives a summary for over 1,500 standards. It also lists some 1,000 publications of the International Organisation for Standardisation (ISO) and over 400 publications of the International Electrotechnical Commission (IEC). Included are a 26-page alphabetical index and a separate index for ISO and IEC publications. Price $1.50.

AS C98 (revised edition), flameproof enclosure of electrical equipment for explosive atmospheres. Covers conditions of testing, the measurement of maximum explosion pressure, gas mixtures, the use of spark plugs for igniting gas mixtures and standardisation of laboratory techniques. Price $2.

AS C161 (revised edition), thermostats and energy regulators. Sets out electrical approvals requirements for thermostats, and covers energy regulators which permit variation of the energy transmitted to equipment by changing the ratio of the on and off times, or by varying the current or voltage or both, in a progressive manner between the lowest and maximum settings. Price 60c.

AS C179, air conditioners. Prescribes construction, marking and testing requirements for electrical approvals purposes for small self-contained refrigerated air conditioners for use at low and medium voltage, whether permanently wired or connected by flexible cord and plugs. Attention is given to protection of electrical components arising from moisture condensation and spillage in the normal operation of these appliances and to environmental conditions of installation. Price 80c.

AS C182, frozen food cabinets. Sets out construction, marking and testing requirements for approvals purposes for refrigerated food commercial cabinets for use at low and medium voltage. Applies to cabinets with either a self-contained or remote refrigerating unit. Price 80c.

AS T43 diathermy equipment. Specifies requirements for the performance and use of microwave, short-wave and long-wave diathermy equipment, including associated component parts, for surgical and therapeutic services. Price 80c.

AS Z24, methods of test for pressure sensitive adhesive tapes. Method 17.1 (revision), resistance. Specifies apparatus and procedure for determining resistance to solvent of electrical tapes by shear strength after immersion in solvent. Method 19.1, flammability. Describes apparatus, test specimen and procedure for determining the burning characteristics of tape wound on a brass rod and ignited. Price 40c each.

HEWLETT-PACKARD JOURNAL, Vol. 21, No. 6, February, 1970. Published by the Hewlett-Packard Co., U.S.A. Inquiries to Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Vic. 3147. Contents: A system for automatic network analysis; Software for the automatic network analyser; Developing accuracy specifications for automatic network analyser systems; Applications for the automatic network analyser; Specifications of the Model 8542A Automatic Network Analyser.

MARCONI INSTRUMENTATION, Vol. 12, No. 4, 1969. Published by Marconi Instruments Ltd., U.K. Inquiries to Amalgamated Wireless (A'sia) Ltd., P.O. Box 96, North Ryde, N.S.W. 2113. Contents: Transmission systems; All solid-state sweeper covers HF and VHF bands; Testing SSB transmitters; PCM testing techniques; Counter type TF 2411; Wide band precision frequency meters, type 6049 series.

MEASUREMENT NEWS, November/December 1969. Published by Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Vic. 3146. Contents include: New network analyser; Keyboard extends computing counter uses; Amplifiers for data acquisition systems; 4-channel instrumentation recorder; DC amplifier has 110dB range: Printout for programmable calculator; Caesium beam standard; Computer-controlled automatic test system.

TECHNICAL COMMUNICATIONS, Vol. 11 No. 102, November, 1969. Published by Mullard Ltd., U.K. Inquiries to Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney, 2000. Contents: Monochrome TV power supplies for 117V and 220V mains inputs; Thyristor power supplies for colour TV receivers; Luminance, colour-difference output, synchronising and AGC circuits; Thermostatic fan control for central heating.

HEWLETT-PACKARD JOURNAL, Vol. 21, No. 5, January, 1970. Published by Hewlett-Packard Co., U.S.A. Inquiries to Hewlett-Packard Australia Pty. Ltd., 22-26 Glen Iris, Vic. 3146. Contents: A DC-to-VHF oscilloscope; A fast-writing, high-frequency cathode-ray tube; A wideband oscilloscope amplifier; Monolithic transistor arrays for high-frequency applications; A fast time base for a high-frequency oscilloscope.

WATVIC SCIENCE RECORD, Vol. 4, February, 1970. Published by Watson Victor Ltd., P.O. Box 100, North Ryde, N.S.W. 2113. Contents: Mettler substitution balance; LKB Uniphor electrophoresis apparatus; Toa blood-cell counter; Radiometer blood gas electrode unit; Qualtex laboratory ovens; RZR stepless speed stirrer; Weller temperature-controlled soldering iron; Toshiba photoelectric tachometer; Nikon stereoscopic zoom microscope; API digital panel meters; Goerz miniature potentiometric recorder; Goertz universal multi-range instrument; Buehler metallographic equipment; Rollei close-up camera.

MULLARD BULLETIN, Integrated Circuit Extra, November, 1969. Published by Mullard Ltd., U.K. Inquiries to Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney, 2000. Contents: Southampton factory expansion; IC manufacture — a process outline; Around the clock computer control; Testing is automatic and easy; Quality control, testing and reliability; TTL reference guide; Room for development; All about Mullard ICs — families, data, application notes.

FR-PET. Published by Teijin Ltd. Japan. Inquiries to Holmesdale Pty. Ltd., 299 Kent Street, Sydney, 2000. An 18-page booklet describing Teijin's FR-PET glass fibre reinforced polyethylene terephthalate moulding resin. It tabulates the grades and physical properties of FR-PET, discusses its useful attributes and its defective points, gives some suggested applications, and cmpares FR-PET with various other moulding materials.

NEW DEVELOPMENTS, Issue B047, February, 1970. Published by Jacoby, Mitchell and Co. Pty. Ltd., 469-475 Kent Street, Sydney, 2000. Contents: Telonic tricolour CRT display system; Waveline direct reading frequency meters; Alfred push-button control unit and plug-in container unit; TRW transistors types PT6669, TP6618, PT6635 and PT6636; Weinschel broadband microwave head; Mycalex series 5 digital data systems; Houston X-Y recorder; Dana digiphase synthesizer; Norma multi-range precision AC meter; EECO fast access magnetic tape unit; Kyoritsu panel mounting meters.

TELEQUIPMENT

economic price performance portability

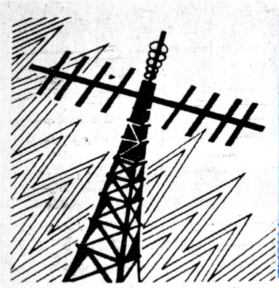
The double beam D52 by Telequipment is a tough little portable oscilloscope for a sensible price. Here are a few of its outstanding characteristics:

- True double beam
- Large 5″ flat faced P.D.A. Tube
- Matched Y amplifiers—
  100mV/cm, DC-6MHz
  10mV/cm, DC-1MHz
- Calibrated sweep speeds—
  18 (+variable)
- Triggering modes—full range, including TV sync
- Weight 24 lb
- Write or phone for more details
- Price $300.00 (plus tax and duty if applicable).

Distributed by Tektronix Australia Pty. Limited
N.S.W.: 80 Waterloo Road, North Ryde 2113. Phone 88 7066
VIC.: 25-27 Alma Road, St. Kilda 3182. Phone 94 0220
S.A.: 128 Gilles Street, Adelaide 5000. Phone 23 2811

TEKTRONIX

S3082



AMATEUR BAND NEWS AND NOTES

All India Amateur Radio Convention

The official report of the First All India Amateur Radio Convention, held in Bombay last December, contains information which should be of interest to all who are interested in the growth of international amateur radio, particularly in Region III.

by Pierce Healy, VK2APQ

As a guest of the Convention committee in Bombay from December 24 to 30, 1969, it was my great pleasure to hear the discussions and to learn first-hand the problems that beset the progress of amateur radio in India. It was also my privilege to meet the Minister of State for Communications, the Chief Adviser of Wireless to the Government, and other Government and business executive officers who attended the convention.

During the course of the Convention it was most interesting to meet individual amateurs, among whom was G. V. Sulu, VU2GV, whose name and work in amateur radio circles have been featured in these notes; also shortwave listeners and many others, to discuss common interests and to answer questions on amateur radio in Australia. It is of interest to note that during his inspection of the official convention amateur station, VU2HAM, the Minister of State for Communication spoke to Brian Warren, VK2BX, of Sydney.

To the committee, fellow amateurs and my host, Dave Dalrymple, VU2OLK ex GM3OLK, I express my deepest appreciation for the hospitality and friendship extended to me during my visit. It was an experience, both from the social and educational points of view, and I am truly grateful for the invitation that was extended to me.

The Official Report issued by the Convention Committee has now come to hand, and is published below in full (except for the speeches by Professor Sher Singh and Shri N. C. Srivatsava referred to in the text, which had to be omitted for space reasons).

OFFICIAL REPORT

The program of the convention began with the opening of the Amateur Radio Exhibition on December 24, at 5 p.m. Shri K. M. Balchandani, Director General, Overseas Communication Services, inaugurated the exhibition. The leading radio and electronic manufacturers participated in the exhibtion. Philips Tata Electric Companies, Nelco, Photophone, Bush, S. R. Standard, Telerad, Cema Vibronics and Asian Electrics had attractive stalls. Bush, Telerad and S.R. Standards Radio gave live demonstrations of television. (Note: There is no television in Bombay.)

The Home Guard, Civil Defence, Atomic Energy Commission and Police Wireless also had displays that were very interesting and informative. A very illuminating assortment of amateur gear (home constructed) was displayed. A working amateur station with the special call sign VU2HAM was in operation and attracted great interest in the DX world. A record number of contacts were made from the station.

A large multitude of people visited the exhibition. Besides witnessing the latest electronic, radio equipments and instruments, they saw for the first time a working amateur radio station in this exclusive Amateur Radio Exhibition and learnt about this glorious hobby. Over 100,000 people visited the exhibition between December 24 and 30, 1969.

Two hundred delegates, which included 75 per cent of the total active amateurs in India, from nearly 60 cities, arrived on December 26 to participate in the convention from December 27 to 30, 1969. This convention was sponsored by 16 different amateur societies and clubs out of a total of 17 from all over India. Delegates also came from DX countries. A total of 271 delegates registered for the convention. A very informative souvenir book was published to mark the occasion.

The convention was inaugurated on December 27, at 5 p.m. by Professor Sher Singh, Minister of State for Communications. Shri Y. A. Fazalbboy, chairman of the steering committee welcomed the delegates and the chief guests. Shri B. S. Dutt, VU2AJ, chairman of the executive committee gave a resume of the preparations leading to the convention and underlined the highlights and the theme.

In reply Professor Sher Singh made a very inspiring speech, the text of which is included in the report. Shri Dave Dalrymple, VU2OLK, chairman of the Souvenir and Exhibition Committee, proposed the vote of thanks. Prof. Sher Singh was taken on an inspection of the stalls in the exhibition and when he visited the amateur station VU2HAM, he spoke over the radio to amateurs to convey a message of goodwill.

Delegates were hosted to dinner by the Radio, Electronics and Television Manufacturers' Association to welcome and meet them.

The business of the convention began at 9 a.m. on December 28, 1969. The first seminar "Amateur Radio in India" was presided over by Lt.-Col. Dady S. Major, VU2MXD. Interesting papers were read and lively discussion took place. At the end of the seminar, Shri V. M. Gogte, Wireless Adviser to the Government, addressed the gathering on the necessity of increasing the activity on the amateur bands. He appealed to the amateurs to be more active and encourage formation of clubs in schools, colleges and technical institutions.

He stressed the point that the cautions sent to amateurs by the Wireless Planning and Co-ordination department of the ministry of communications for violating certain rules and regulations were only for corrective action and were not intended as a punishment. He conceded that it does take some time to issue the licence initially, but once it is issued, it remains for good with the licensee.

He then answered a number of questions from delegates on all problems brought to his notice and this was a very illuminating encounter indeed. Delegates were happy that for the first time they had the opportunity to meet the Wireless Planning and Co-ordination chief in person and to discuss their problems with him.

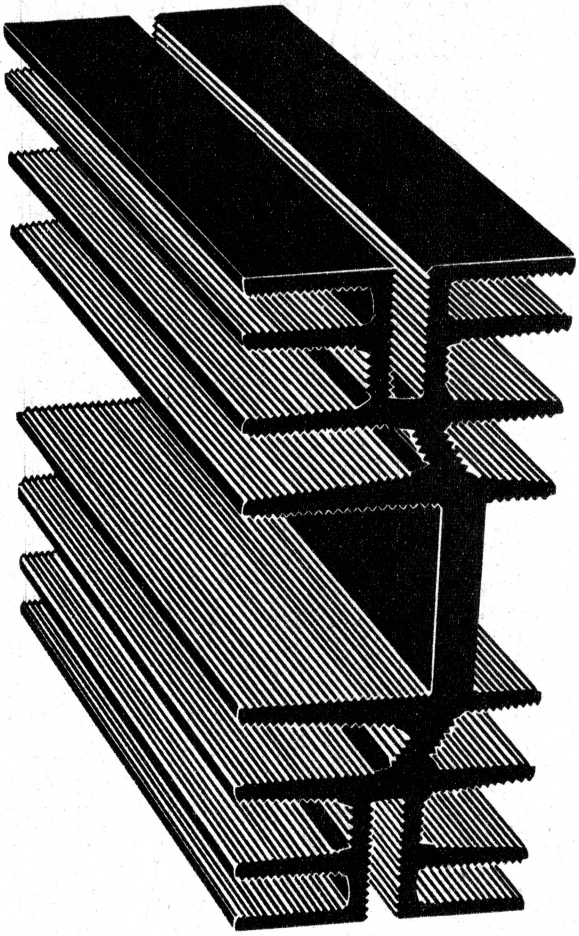
The other three seminars, namely — Technical Aspects of Amateur Radio; Amateur Radio Service and the Nation; and The Union of Amateurs — were presided over respectively by Shri V. J. Bhatt, VU2RX; Commdt. Gen. Udyan Chinubhi, VU2UD and B. S. Dutt, VU2AJ. Again very interesting papers were presented and lively discussion followed. A separate report is being prepared.

Two very interesting lectures were presented during the convention. Pierce Healy, VK2APQ, spoke on important aspects of amateur radio and detailed the services rendered by amateur radio to the nation and society in his country. He also gave details of the launching of Australia's Oscar V and how the

News and notes of Divisional and Club activities submitted for inclusion in these columns should be forwarded direct to Pierce Healy, 69 Taylor St., Bankstown, N.S.W. 2200.

WF HEAT EXCHANGERS

FOR TRANSISTORS, DIODES, THYRISTORS



NEW

WF *MiniFin*

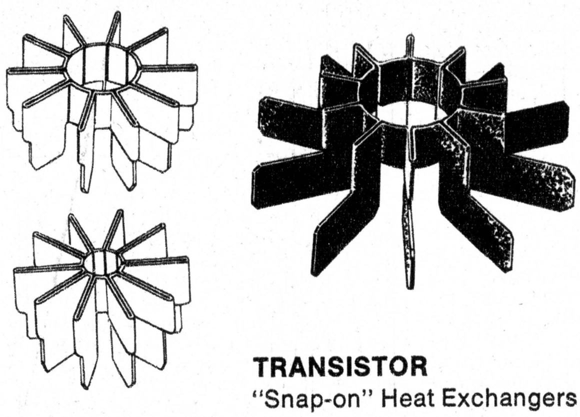
WITH

***Hexafit* mounting**

FOR MEDIUM POWER DIODES & THYRISTORS

Hexafit, a new concept in mounting systems, is a unique feature of the new WF MiniFin. Although designed for 20 U.N.C., **fluting** allows any type threaded ¼″ bolt to be affixed in any of the six channels anywhere along its full length making easier, simpler mounting at **less cost.** No drilling or nuts are necessary. The bolts alone provide firm and rigid mounting.

The fluted surface allows high heat dissipation in compact profile. Offset mounting provides protection whilst the device is still accessible within the outline of the MiniFin.

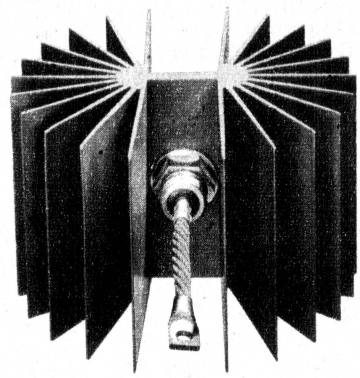


TRANSISTOR

"Snap-on" Heat Exchangers

HE 101 fits JEDEC case styles to 18, 24, 28, 40, 44.
HE 102 fits JEDEC case styles to 5, 9, 11, 12, 16, 26, 29, 33, 39, 42, 43, 45.
HE 103 fits JEDEC case styles to 8, 38, 48.

Available ex stock



FOR HIGH POWER DIODES & THYRISTORS

MULTIFIN EXTRUDED ALUMINIUM HEAT EXCHANGER enables FULL RATED OUTPUT to be obtained from a wide range of medium and high power semi-conductor devices WITHOUT THE USE OF COOLING FANS.

MULTIFIN is available in: ● Plain lengths, cut to order ● Anodised and machined lengths ● Spot faced and drilled.

WF WARBURTON FRANKI

ADELAIDE 56-7333; BRISBANE 51-5121; HOBART 2-1841; LAUNCESTON 31-3300; MELBOURNE 69-0151; MOUNT GAMBIER 2-3841; NEWCASTLE WEST 61-4183; PERTH 8-4131; SYDNEY 29-1111; WOLLONGONG 2-5444.

VU2s could observe telemetry and other data from it. The talk was supplemented by colour slides and a colour movie of field-day activity. Delegates expressed gratitude to Pierce Healy for his well-planned talk and all the trouble he took to join the convention and give us vital information on important aspects of amateur radio.

Another interesting lecture was given by Major J. K. Desphande, VU2ED, which was equally illuminating and informative with practical demonstration of making up a singe-sideband crystal filter, which was very much appreciated by the delegates.

The chief guest for the plenary session on December 30, 1969, was Shri N. C. Srivatsava, Secretary Ministry of Communication. The plenary session saw the presentation of final reports on the seminars by the chairman of the different seminars and all were impressed by the frank and forthright way these reports were drawn up and presented. Reports and resolutions are also included as part of this report.

The most important outcome of the convention was the formation of a "Federation of Radio Amateur Societies and Clubs in India." A committee with Commdt. Gen. Udyn Chinubhai, VU2UD as chairman and M. V. Chauhan, VU2MV; T.P. Sheth, VU2TP; B. S. Dutt, VU2AJ; G. V. Sulu, VU2GV; D. W. Dalrymple, VY2OLK; Maj. J. K. Deshpande, VU2ED; K. G. Girimaji, VU2GX; Saad Ali, VU2ST; T. K. Rao, VU2TO; P. S. Kochhar, VU2QH; V. J. Bhatt, VU2RK; R. M. Pandya, VU2MQ, (convenor) as committee members, will go into action immediately to bring all amateur radio interests in India under one banner and achieve the program drawn up by the convention.

The chief guest, Shri N. C. Srivatsava, was impressed by the large gathering of the amateur radio fraternity present at the convention and the results achieved. He was very happy with the formation of a federation of all Indian amateur radio interests and complimented the convention for taking the right step. He blessed the new federation and assured his department's fullest co-operation.

Shri N. C. Srivatsava told the gathering that the XIIth Plenary Assembly of the International Radio Consultative Committee of the International Telecommunication Union will meet in Delhi from January 21st to February 11, 1970, on the invitation of the Government of India. The delegates will include many amateur radio enthusiasts and it would be appropriate to take advantage of their presence to popularise this scientific hobby.

He invited the organisers of the convention to take this opportunty to arrange a get-together to meet their counterparts from abroad at Delhi during the C.C.I.R. session. He invited Indian amateurs to participate in a proposed exhibition of radio equipment by displaying and demonstrating their equipment, to create interest in the student community as well as manufacturers of equipment.

Thus concluded this most memorable convention, the like of which has never been held in India. Momentous decisions were taken which we are confident will pave the way to the healthy growth of amateur radio and open up new horizons for achievement of ideals and aspirations.

Our amateur correspondent Pierce Healy, VK2APQ, with a group of delegates to the First All India Amateur Radio Convention. Some of the lady delegates are licensed amateurs.

Prizes and awards to exhibitors and delegates for various achievements in the respective fields were also presented by Shri N. C. Srivatsava. A detailed report on this aspect is being prepared. The proceedings were concluded with a very illuminating speech by Shri Saad Ali, VU2ST, who made a very excellent job of rounding up the convention activities. He paid tribute to all who made the convention such a grand success, surpassing the most optimistic expectations. He attributed this success mainly to the delegates who came to attend the convention in such a large number and at such great inconvenience to themselves. Undoubtedly amateur radio will thrive on the results achieved and reach new heights in time to come.

Amateur Radio in India

The first Seminar was called to order at 0930 hours on December 28, 1969, to discuss the papers submitted on the subject of "Amateur Radio in India," Lt.-Col. Dady S. Major, VU2MD, was in the chair. Mr V. P. Asar, VU2VA, was co-chairman and Mr Saad Ali, VU2ST, the principal speaker.

The seminar was well attended and the discussions were lively. It was brought out that as against a total of approximately 450,000 radio amateurs in the world we have only 500 in India which gives an average of only one per million population as against the world average of 1,200 per million.

Trying to fathom this situation we find that in pursuit of the hobby the Indian amateur faces problems on many fronts. Not only the common man but many people from educated classes, even in the technological field, have never heard of amateur radio. Many of those who know something about it consider it to be a luxury, forgetting its creative and scientific aspect and of the few who do recognise this only a few aspire to become radio amateurs because of the following difficulties they have to face:

(a) Inordinate delay in the issue of licences; in certain cases several months after appearing for Government examination.

(b) Non-availability of equipment and components. He has somehow managed to make do with the World War II disposals so far. Even that source is now drying up if not actually exhausted. Instead of any prospect of improvement on this front it is found that the problem is becoming more and more acute, seriously hampering the growth of this hobby in the country. Due to the low level of income it is all the more necessary that the Indian amateur should get the correct equipment and components for the money spent.

(c) Lack of facilities for training prospective amateurs.

(d) Lack of adequate publicity.

(e) the rigidity of Government regulations is inhibiting the growth of amateur radio in our country. In spite of showing our usefulness to the nation at the time of the P and T strike, we have not been given any worthwhile opportunity to prove our usefulness in times of emergencies. A little more trust and confidence reposed in us, and further necessary relaxation of regulations by the Government, we assure will be more than repaid by the amateur in his service to the nation.

(f) The amateur in India, as anywhere else in the world plays a vital role in the field of advancement of wireless communication technology. The self-generating fraternity, without taxing the Government or society, creates technical skill of high order. It deserves encouragement by all concerned.

It was resolved that the following

points be taken up for further consideration.

(a) Publicise our hobby in schools, colleges and technical institutions with practical demonstrations.

(b) Approach different user departments, through the Wireless Planning Co-ordination Department of the Ministry of Communications, for the release of surplus equipment to amateurs at reasonable cost.

(c) Approach manufacturers with the request to produce equipment and components for amateurs at reasonable cost.

(d) Request the Wireless Planning and Co-ordination Department to expedite the issue of amateur licences.

(e) Organise exhibitions and displays in different towns for the benefit of the general public.

(f) Organise clubs at different places where practicable for the training of prospective amateurs.

(g) Request Government for grant of import licences to amateur radio societies, clubs and individual amateurs to import essential requirements not available locally.

(h) Request the Wireless Planning Co-ordination Department to:

(I) Grant mobile licences.

(II) Freely allow amateur activities such as field days, hidden transmitter hunts, etc.

(III) Allow third-party traffic by radio amateurs in matters of domestic emergencies of the general public at large without any pecuniary gain to the amateur.

(IV) Allow medical consultations by doctors from any amateur radio station.